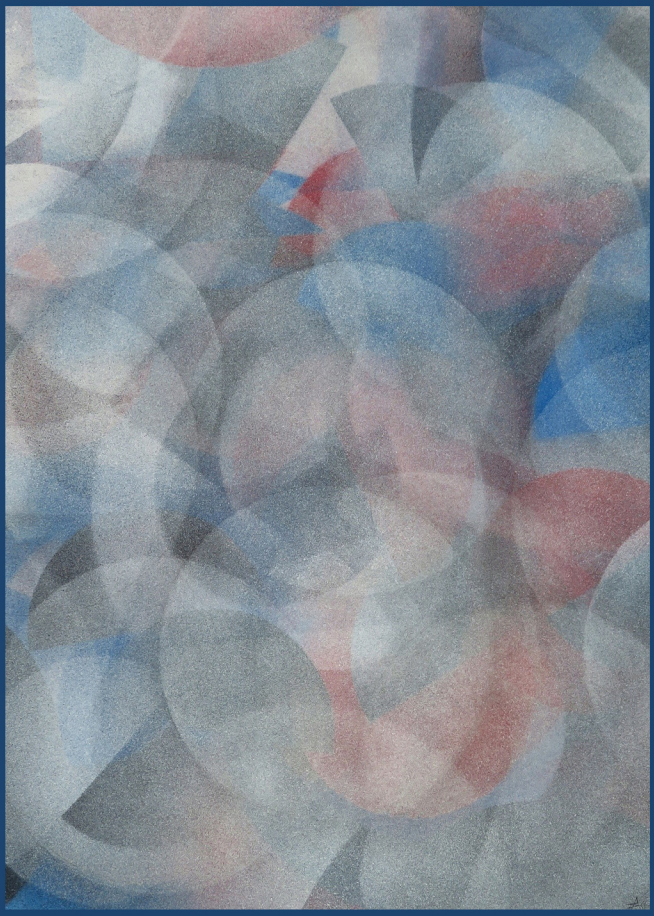
The Theory of Narrative Thought



Lee Roy Beach
James A. Wise

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By

Lee Roy Beach and James A. Wise

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This book is dedicated to the Barbaras in our lives.

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PREFACE

We have been thinking about thinking for many years. The product of that effort is the Theory of Narrative Thought (TNT) which is a refinement of Image Theory (Beach & Mitchell, 1990) and was developed over the course of three previous books. The first of these books (Beach, 2010) contains the earliest, and in retrospect, the embarrassingly naïve, version of the theory, focusing on its implications for decision processes and schemes for helping people make decisions. The second book (Beach, Bissell, & Wise, 2016) contains a more developed version of the theory and further implications. The third book (Beach, 2019) expanded the theory's conceptual underpinning in terms of the narrative structuring of experience in general, which led to an improved statement of TNT. This fourth book retains the 2019 statement of the theory and focuses on recent refinements, its neurological, evolutionary, and mathematical roots, and on additional applications and implications.

We confess that the theory's name, the Theory of Narrative Thought, really isn't very accurate. Over the course of the three previous books, we tried different names but somehow fell into the habit of referring to it as 'TNT' in discussions between ourselves and with others, which has pretty much locked us in. Really, the theory is about cognition in general, with thought being something of a sub-category (called derived narratives). So, we'll apologize now for the confusion and hope you can look beyond it as you read. Perhaps this is a case of "...a rose by any other name...".

A warning to new readers, our use of the word "narrative" only coincides in part with the conventional use. Yes, we're referring to a story-like structure, but it isn't always a story and it isn't composed in the way an author or speaker might intentionally compose a tale—in fact, there's no intention involved at all. It merits being called a narrative simply because it is the past, present, and the future they imply, held together by causal rules. It is the structure, not the content, and "you" don't construct it. It simply is the way in which the brain structures experience. Narratives, in the conventional sense, derive from this structure, which we call the *prime narrative* to emphasize that it is conceptually different and more fundamental than the stories we all tell ourselves and others. That prime narrative structure of experience came first and conventional stories reflect it, not the other way around.

The format of this book differs from the others in that it is a collection of loosely linked essays. We hope you find them interesting enough to grant TNT further consideration and stimulating enough to merit research and application.

Two final things. First, we thank Ms. Pamela Sloughter for her hard work tracking down some of the rarer early documents discussed in this book. Second, unless you intend to be rude, we would very much like receiving an e-mail about your thoughts on TNT at leerbeach@aol.com and/or jamesawise@me.com.

PART I

THE THEORY

We begin with a description of TNT; a refresher for old friends and an introduction for new ones.

ESSAY #1:
THE THEORY OF NARRATIVE THOUGHT (TNT)

TNT posits that the brain structures experience as a narrative in which the past and present imply the future, allowing identification of potential threats in that future, and guiding action to prevent, avoid, or diminish them before they occur. In other words, cognition is primarily about what happens next and how to avoid or take advantage of it. In addition, narratively structured experience provides the shape and content of the narratives used to think and to communicate those thoughts to others.

We will return to this at the end of the essay, but it is best to understand from the beginning that TNT's central tenet, the prime narrative, replaces the traditional concept of "mind as agent" as the central feature of cognition.

The Theory

TNT begins with the proposition that a primary function of the brain is to synthesize elements into coherent wholes (e. g., Ivanitskii, 1994, 1996; Moon & Pae, 2019; Tononi, 2004, 2008; Kringelbach & Deco, 2021). Perception is the brain synthesizing sensations into coherent time and causally bound *events*. Memory is the brain synthesizing events into coherent *episodes*. And, of present interest, cognitive structuring is the brain synthesizing both episodes and their component events into coherent *narratives*. Which is to say, the brain creates events out of sensory experience, which are the visual, auditory, kinesthetic, olfactory, etc. sensations that herald changes in the internal and external environments (which we'll call, your *habitat*[1]). But events are useless by themselves, so the brain creates episodes out of events that occur together, bound in time or otherwise linked. And, because episodes are useless except in reference to what preceded and followed them, the brain indexes episodes by time (Reddy, Zoefel, et al, 2021). Doing this creates a logical structure, a narrative, about how the past led to the present and what that implies for the

[1] We share the environment with other people, animals, etc. But our unique bit of the environment is our habitat, and everyone's is slightly different.

future.[2] (Because it is awkward to have to speak of both events and episodes in tandem, and because events are causally the more basic of the two, we use the single word, event, to stand for both of them.

Narrative Constancy

A narrative, any narrative, is a sequence of events ordered by time and causality (Atkinson, 1978; Carroll, 2001; Polkinghorne, 1988). That is, narratives are not just about what events happened, they also are about the order in which they and other events happened and what caused them to happen (Atkinson, 1978).[3]

Narrative constancy refers to the observation that narratives can be presented in different ways without distorting the underlying story. For example, narrative order sometimes appears to violate temporality by interpolating earlier or later events, as in flashbacks and flashforwards in novels, movies, and TV or in the undulating flow of everyday conversation. But the recipient (reader, viewer, or other conversationalist) understands that the interpolated events took place earlier than the events in the main thrust of the narrative and are included because of their bearing on those events and thrust. Indeed, the ability to understand interpolations reveals that both the listener and the narrator recognize that events unfold over time and that earlier events have meaningful implications for later events.

In addition, a narrative can be recounted in numerous ways as long as each version includes the key events and respects their temporal and causal order. This is evident when two people describe the same series of events. Not only do they seldom tell exactly the same story, seldom do either of them tell it exactly the same way twice.

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[2] Lou (2021) presents a similar argument for the brain as a synthesizer, except instead of events, episodes, and narrative, he uses the terms letters, words, and sentences. He explores the architecture of neural circuits needed for this three-step synthesization and provides neuroscientific evidence suggesting that, indeed, the brain has such an architecture.

[3] See Mar (2004) for a review of the neuropsychological research related to story comprehension and story production, their common neural mechanisms, and the implications for cognition. Mullally & Maguire (2013) showed that memory, imagination, and prediction all use the same parts of the brain operating as a single system. And Reddy, Zoefel, et al (2021) report that temporality of events is represented in specific cells in the hippocampus.

The Prime Narrative

That different orders and different versions of events can be regarded as accurate recounting of the same story suggests that they reflect something more basic, an underlying temporal/causal structure from which the different versions derive. This basic structure is called the *prime narrative* (Beach, 2019); it provides the basic means of understanding of how one's life has progressed from the distant past up to the present. The stories you tell about yourself and others about what you want, believe, and find meaningful all derive from the prime narrative, but no story you can relate can fully encompass it. More to the point, the prime narrative is your foundation for dealing with your habitat and yourself.

Narrative Future

The foregoing is about the past and present, but what about the future? Clearly, you have some notion of what it will be. If you read a mystery novel, you can predict what is likely to happen next (although an accomplished author will ensure that you predict incorrectly—which is what makes it a mystery). If someone tells you something, you usually can see the implications for what will happen later. And when you think about your present circumstance, and how you reached it, you can imagine where it will lead.[4] In the latter case, you probably are right more frequently than you are wrong, especially in the short term. If you could not correctly anticipate what is going to happen in the next few moments, even the next few hours or days, you would not know what to do next; you would live in a state of suspension, anxiety, and constant surprise.

Of course, the future has not yet happened so no one can say with certainty what it will be. Humans have invented a variety of tools for dealing with this fact—fortune telling, divination, statistics, forecasting—most of which require the user to have special skills or the help of people who have those skills. But, lacking expertise or an expert, tools such as these are unavailable to most of us. Left to our own devices, we must rely upon our "intuitive" predictions about the future. And, because our predictions are all we have, we must treat them as accurate and act accordingly, hoping for the best.

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[4] We'll discuss imagination and TNT in Essay #14 but note that recent research (Lee, Parthasarthi, & Kabe, 2021) suggests that imagining the future and evaluating whether that imagined future is good or bad depends on two different parts of the brain, which fits well with TNT's separation of prediction of the future from evaluation of its threat.

There are many reasons for trying to predict the future but, in the long run, the primary reason is survival and its near-relatives, security and well-being. That is, prediction can reveal potential threats and suggest actions to avert them or soften the blow. Of course, not all threats are about survival, but expectations of distress, discomfort, or pain are sufficient to warrant mitigating action. Threats do not even have to be physical; potential aggravation and hassle, loss of esteem, or the possible failure of opportunities or expected benefits to materialize are all threats that require mitigation. But the point is, however serious, the most efficient way to handle threats is to anticipate them and deal with them before they can cause damage. Doing this requires use of the causal structure of the prime narrative about what has happened and how it led to what is happening now to infer what will happen next (and next, and next, etc.).

Causal Rules

Physicists may not be sure that the world is deterministic (Musser, 2017), but humans and other creatures behave as though it is (Cheng, 1997; Holyoak & Cheng, 2011; Lagnado & Solman, 2016; Sobel & Kirkham, 2006; Solman & Lagnado, 2015).[5] They operate as though every event that happens has been caused by an event that happened previously and will be the cause of an event (or events) that happen subsequently. Moreover, when a specific event(s) follows reliability from a previous specific event, they interpret the relationship between the two as a *causal rule*. Interpreting temporal relationships as causal rules turns what would otherwise merely be a list of events into a narrative about how events in the moderately distant past caused events in the immediate past, how this caused what is happening now and, most important, how it will cause what will happen next.[6]

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[5] Moreover, recent evidence suggests that the brain's operation is basically causal, i.e., assuming it is permits "capture ⌈of⌉ the causal flow of information, i.e., how activity in a given region can be shown to causally influence activity in another." (Kringelbach & Deco, 2021). Additionally, research (Duan, et al., 2021) suggests that detection of causal relationships between actions and their outcomes is mediated by the caudate nucleus and is enhanced by the anterior orbitofrontal region of the prefrontal cortex. See also, Danks (2009)

[6] Causal thinking may seem obvious and unremarkable because it is so familiar, but it is neither. For example, we could have evolved to think probabilistically instead of causally, but causality is much simpler and more efficient and, most of the time, it does a good job. In fact, probability, as a formal mathematical theory, was invented largely to describe the uncertainty we often feel about our causally derived expectations about the future (see Greenland, 2020 for related arguments).

Causal rules have direction and directness. Direction means that occurrence of an event influences, or at least implies, the occurrence of a specific subsequent event(s)—i.e., causality works forwards, not backwards. Directness, as the name implies, is how straightforwardly that influence is exerted. The most direct rules, are between a cause and its effect, A→Z. Slightly less direct rules are between effects that are the result of an intermediary event that was itself directly caused, A→(K)→Z. Even less direct rules operate through more intermediary events, A→(K→M)→Z. And so on. But, in all cases the rule is regarded as being between events A and Z; everything in-between is merely supportive of that rule.

Intermediate events have their own links (*lateral links*) with yet other events that are tangentially related to what is happening at the moment. Lateral links are enriching because they increase the interconnections among events, but they also introduce opportunities for things to go in unpredictable ways. Thus, with only direct links, everything would be simple (no lateral links) but highly determinant because every event would have only one cause and one effect. A mixture of direct and slightly less direct links would be richer yet (because of lateral links), but less determinant because the intermediate events may or may not be particularly determinant. Adding even less direct links, and more complex rules, would be even richer (even more lateral links) but even less determinant.[7] And so on. The longer the chain of events required to get from A to Z, the more opportunities there are for things to go wrong and for something instead of Z to occur. Which means that the less determinant the causal rule, the less reliable it is.[8]

Reliability can mean something like the proportion of times the rule actually produces (correctly predicts) Z. But, even though the rule's track record is important, so is its determinacy. Even without a track record, a more determinant rule stands a better chance of being right than a less determinant rule, if only because it is simpler and offers fewer opportunities for things to go wrong. Additionally, rule reliability reflects the degree to which the rule is *appropriate* to the current circumstance. The more closely the current conditions approximates conditions(s) in which the rule previously predicted Z, the more appropriate it is. (Of course, the broader the range of circumstances in which the rule has worked before, the more it is likely to be appropriate this time.) A third contributor to rule reliability is

[7] Complex causal rules also are known in the literature as causal mechanisms (see Johnson & Ahn, 2017; White, 2013).

[8] Meder, Mayrhofer, & Waldman (2014) have demonstrated that when acquiring and using causal rules, people take the lateral links into consideration rather than relying solely upon the main linkage.

the *credibility* of the source of the rule. Many rules are learned from experience, but as many, or more, are acquired from other people, textbooks, and the media. Together, determinacy, track record, appropriateness, and source credibility determine the rule's reliability—its dependability.

Actually, reliability is not a property of a rule. The rule is simply an "A→Z" proposition that is either true or false under particular circumstances. Reliability is an appraisal by a sentient being (e.g., you) of its certainty/uncertainty, its degree of belief that the rule's A actually will be followed by Z.

The Expected Future

Your prime narrative is the foundation for a causal tale that unfolded over time, ending with what is happening now; "This happened because of that, which caused something that resulted in something else that is happening right now." In principle, the tale ought to stop at the present because the future has yet to happen, so there are no events to add to the narrative. But it does not. Because past and present events are organized by time and causality in the prime narrative, the future always is implicit as yet-to-occur effects of past and present causes, the results of what is happening right now and what led up to it. Causality implies predictability; if, in the past, A caused Z, then if A is occurring now, the future occurrence of Z is implied. At the moment that A is occurring, Z is merely a causal implication because it has not yet happened, but it is the best prediction about what, in fact, will happen—this is called the *expected future*.

And this is where rule reliability matters. If the rules for producing expectations aren't wholly determinant, appropriate, and credible, you are uncertain about their implications for the future and therefore more hesitant about the future than you would otherwise be. Hesitancy translates into unwillingness to invest energy and other resources in that implied future.

Coherence and Certainty

When the prime narrative's constituent events are strongly linked by direct, reliable causal rules—when the story it tells is straightforward—it is coherent. Which also means that the brain's synthesizing processes have done their job; coherence is the degree to which it has brought efficient order to otherwise diverse elements.[9] Which also means that you feel confident

[9] Emotional negativity results from violation of one's standards for how the world should be, so a threat is the degree to which the events in the expected future fail to conform (violate) those standards. This is explained in Essays #5 and #9.

that you understand what is going on and that the (implied) expected future is what, in fact, will happen. And, because there is no way of telling if the prime narrative is or is not "true" until its predictions about the future prove accurate or inaccurate, coherence and confidence are surrogate for truth and, therefore, for believability. That is, if the prime narrative is coherent, you are inclined to believe that it and its implied future are true until proven otherwise.

Of course, it also works the other way; low coherence suggests the prime narrative is wrong, which means you do not really understand what is happening and why. And this results in uncertainty, not just about what is going on but also about what is going to happen as a result. It boils down to this: Uncertainty creates anxiety, which is emotionally negative. It is the potential for this negative emotion that prompts action to increase the prime narrative's coherence by revving up the brain's synthesizing processes in an attempt to clarify the path from the distant past to the present and into the future.[10] In this sense, low coherence, and the high uncertainty that it engenders, is a threat just like any other threat—something that must be mitigated.

Threats

Threats are expected events that, should they be allowed to occur, will significantly violate one's values or preferences, called one's *standards*. Appraisal of the degree of violation turns on the discrepancy between what one expects to happen and that which one's standards dictate *should* happen. The greater the discrepancy, the greater the anticipated emotional distress, hence the greater the potential threat.[11]

Presuming that the expected future is an accurate prediction of what will happen (and it is all you have to depend upon, so the presumption is efficient), your comfort, even survival, depends upon identifying and mitigating threats before the future becomes the present and the threatening events and their concomitant negative emotions become reality. This requires an evaluation of each event in the expected future and a decision about its potential for negative consequences and emotions as well as a decision about the overall negativity of the entire expected future. That is, the *usefulness* of the prime narratives' implied future is not that it provides a

[10] This will be explained more fully in Essay #5.

[11] Appraisal is modeled by the discrepancy test, about which more is said in Essay #11. Why threats are the focal point of TNT is explained in Essay #6. For a review of the nature of emotion see Tyng, et al. (2017),

glimpse of the future *per* se, it is that it provides a glimpse of the potential for that future violating one's standards and the emotional negativity that will follow. Few futures offer unalloyed joy but when the overall negative potential is significant, action must be taken to change the future before it happens.

Threats are not solely about the danger of bad things happening. They also are about the danger of losing existing good things or losing the opportunities to attain good things—both of which are forms of harm that prompt negative emotions (grief, disappointment). Too, not all threats are dire. Day to day life seldom presents extreme, life-threatening danger—except perhaps when you are driving your car. Most daily threats range from mild to modest potential discomfort and discontent that requires minor mitigating adjustment.

Rules and Actions

Actions are interactions with your habitat that are guided by the same causal rules that were discussed above. Acquired through both experience and instruction, these rules specify the results that your actions can be expected to cause, thereby telling you what to do to produce a particular result—specifically, threat mitigation. They also specify the results that other people's or natural forces' actions can be expected to cause, either spontaneously or in response to your actions, thereby telling you what to expect as repercussions of your actions.[12]

A sequence of contingent action rules is a *plan*; where contingency allows for doing either this or that depending upon the result of previous actions in the sequence or reactions to your actions by nature of others.

Implementation of a plan consists of the sequential execution of each causal rule in the plan. As each step produces a change in the internal or external environments, the change is sensed, perceived, synthesized as an event, and changes the prime narrative to represent what is going on right now (Essay # 5). Changes in the prime narrative cause changes in the implied future. Because action is primarily undertaken to mitigate threats, the resulting changes in the prime narrative and the implied future should, if successful, make the new implied future less threatening than its predecessor. Because actions in the sequences are contingent, if an action results in the implied future becoming less threatening, the next action(s) in the sequence is executed. If an action increases the threat, new action(s) is

[12] Language, too, is action (Austin, 1962: Searle, 1969) if only in that it causes both ourselves and other people to behave in ways that we otherwise would not have.

retrieved from procedural memory to correct for the setback and decrease the threat. In short, threat mitigation is a feedback loop in which the reference variable is perceived threat.

Failure

Of course, to expect is one thing, to actually have that expectation realized is another. When something other than what was implied, and therefore expected, happens instead, it is a sign that the expected future is an implication of an incomplete or incorrect prime narrative. Put another way, the discrepancy between what is expected and what actually happens is information that has two aspects. First is the size of the discrepancy, which is how far off the mark the expected future was. Second is the impact of the discrepancy, which is the degree to which incorporation of these unexpected events into the prime narrative will reduce its coherence. By definition, surprises don't fit, or they wouldn't be surprises. So, incorporating them, which must be done because, after all, they *did* happen, reduces the prime narrative's coherence. As we'll see directly, reduced coherence is a bad thing for a synthesizing brain. So, to restore coherence, the prime narrative must adjust (resynthesize) to accommodate the unexpected events. This does not require reflection or conscious effort on your part, it simply happens as a result of your brain's synthesizing principles for narrative structure, motivated by its (the brain's) requirement for coherence. As we'll see in Essay #5, this accommodation is how the prime narrative is updated to correct existing internal errors as well as how it incorporates new information about changes in the habitat that made its implied future wrong.[13]

[13] Establishment cognitive science works on the assumption that the brain evolved to receive sensory information about the environment with which it creates a model of that environment upon which reactive behavior is based. This is called the "outside-in" approach to cognition (Lyon, 2021). This is not the case for TNT; the prime narrative is not a model of the environment, although it contains information about the environment in the form of events and causal rules. But, the central role of standards in decisions about the future is decidedly "inside-out". The result is that TNT is both "outside-in" and 'inside-out". The focus is on the future and what to do about it. Any modeling of the environment is simply in aid of this focus, not an end in itself.

Derived Narratives: Narrative Thought and Communications

Private Derived Narratives

By the time you became an adult, the content of your prime narrative had two sources. One source was raw experience—commonly referred to as intuitive knowledge. The other was feedback from your own thinking and from what was communicated to you by others. The latter was afforded, in large part, by the acquisition of language, which allowed elements of the prime narrative that were pertinent to the situation to be synthesized into a "mini-narrative" related to that situation. That is, linguistically encoding cogent parts of the prime narrative produces a *derived narrative*, a sort of contextually delineated copy of a portion of the experiential prime narrative that can be used for thinking and communicating.

It is useful to classify derived narratives as being about raw and empathetic experience, called *chronicle derived narratives*, or about how to do things, called *procedural derived narratives*. (Beach, 2010; Gerrig, 1994). Chronicle derived narratives are what we tell ourselves (thinking) and others (communicating) about what is going on, how it came to be that way, what we expect to happen, and what the threats are. They also are the vehicle for extending the prime narrative's immediate predicted future by elaborating it into a longer-term story of what might possibly happen in a week, a month, a year, or even longer.

Procedural derived narratives are about action and are as important as chronical derived narratives—there is no point in knowing what is going on and what will happen if you can't do anything about it. Procedural derived narratives are the stepwise, detailed stories we tell ourselves and others about how what to do—they are the plans that guide action.

Like chronicle derived narratives, procedural derived narratives come from your own experience, such as trial and error learning, and procedures you are taught by others—parents, peers, teachers, and society in general. Part of the genius of humanity is the collective, cultural elaboration of procedural derived narratives into science, religion, government, etc., all of which, one way or another, exist to mitigate threat.

Chronicle and procedural derived narratives help you mitigate threats by changing your own and others' behavior and by guiding manipulation of physical objects and abstract concepts. But, they also serve the other functions—sort of by-products. Novels, TV, gossip are chronicle derived narratives that forestall unpleasant boredom but also are desirable as entertainment and instruction. Similarly, driving a car, building a bookcase,

texting a friend require procedural derived narratives to reach desirable ends (i.e., to avoid not reaching them) but the action itself can be positive. Indeed, everything studied by social scientists derives from chronicle and procedural derived narratives, from their fundamental function in threat mitigation to their being co-opted for broader purposes, such as education and entertainment. And both kinds of narratives reflect their origins in the prime narrative by being temporally/causally structured as past, present, and future.

Public Derived Narratives

When a private chronicle or procedural derived narrative is shared with other people, it becomes a public derived narrative. Then it frequently becomes more involved and abstract as other people contribute to it, hone it, and apply it more broadly. In some cases, this is the end of it. But, in other cases and with enough elaboration, it becomes something very elegant—mathematics, the basic and applied sciences, the arts, and all the rest. Or, it becomes something ugly—conspiracy theories, racism, hatefulness. Both elegant and ugly public narratives are part of humans' shared culture, and they all have their origins in the human ability to encode the prime narrative into language, to communicate it to ourselves and others, and to incorporate the results back into the prime narrative.

Finally, lest we become too focused on written or spoken language, derived narratives involve more than just words. Gestures, laughter, and facial expressions can be eloquent; "a kiss is a conversation without words". And laughter conveys a multitude of meanings (Glenn & Holt, 2013). Even so, words are a major part of it, the primary tool for expressing the multiplicity of narratives that people bring social interactions and that help them know their world and themselves through internal monologue. The key word in that last sentence is "tool," which is anything that helps us in our efforts to extend the future, identify threats, and formulate actions to deal with them before they overtake us.

Afterword

We have tried to keep this discussion of TNT short to ensure that the basic idea is not buried in detail or side issues. That basic idea, in case you missed it, is that avoidance of death, even discomfort, ultimately depends upon being able to anticipate threats and to act to eliminate or diminish them before they happen. Basically, TNT is about how this might take place.

TNT is a theory of the mind in which the usual concept of mind as an active agent is replaced by the prime narrative, which is both inactive and has no agency (see also, Gough, 2021). It merely is a self-organizing structure in which past, present, and expected future events are ordered by time and causality. Expectations are the causal implications of past and present events. They serve to identify potential future threats, triggering mitigating action. They also define surprises—discrepancies between what is expected and what actually happens—triggering corrective changes in the prime narrative that make subsequent surprises less likely.

Language supports abridged versions of the prime narrative, called derived narratives, which in turn support communication with oneself and others. Communication with oneself supports thinking. Communication with others supports social interaction and information exchange. The products of both thinking and social exchange are incorporated into the prime narrative as present (as they happen) and past events (subsequently), thus influencing expectations about future events.

Central to this is the characterization of the brain as a synthesizer. This doesn't merely move mind to the brain, because there is no agency in what the brain does. It simply synthesizes whatever is at hand according to its internal rules; primarily proximity in time and space. Much research has been done to identify the connections among functional units of the brain, but less has been said about what those connections are for—synthesizing, making larger bundles from smaller bundles.

Note that TNT does not attempt to explain consciousness. This is simply because consciousness is both the process and result of the brain synthesizing elements for the prime narrative as well as synthesizing derived narratives for thought and communication. It has no special status because it isn't special; it is merely verification that the brain and the prime narrative are functioning as they have evolved to function.

This position is consistent with research; a conscious decision to act does not lead to the brain being "fired up; to instigate the action" (Libet, 1985). Quite the opposite. The brain "fires up" about a half second *before* a conscious decision is made. This suggests that brain activity is a prior and necessary condition for consciousness, not something apart or something special.

Testing TNT

Suppose it were possible to assign all cognitive theories to different levels of a space in which those at the lower levels were narrowly focused on specific phenomena (e.g., a theory about the part of the brain involved in

some specific cognitive task) and the theories at higher levels are increasingly broad in their focus. Of course, higher level theories frequently have lower level theories imbedded within them. For example, TNT has a decision theory, called the discrepancy test, within it (Essay #11). So, TNT, including its discrepancy test, would be at a high level and the discrepancy test alone would also be at a lower level.

What constitutes evidence for or against a theory depends on its level. Evidence for lower level, focused theories is direct; experiments, case histories and the like. Evidence for higher level theories is less direct, starting with support for its component, lower level theories and proceeding to how reasonably it fits (is contextual) with other theories at its own and adjacent levels and with relevant parts of, brain physiology and neurology, evolutionary biology, and mathematics. That is, for a cognitive theory to be valuable, it must take its place in the context of the broader science of cognition, and allied disciplines. To the degree that it fits, support for these other areas is support for it. In short, support for a theory like TNT comes upward from its component lower level theories and laterally from its contextual fit with relevant higher-level theories in cognition and allied disciplines. And there is a third direction—how well the theory fits within the context of real-world issues. After all, cognition is about the world, so a theory of cognition should both fit and offer insights into the sorts of things that people actually think about, talk about, and form expectations about.

As you proceed through the following essays, you'll note the profusion of citations. These aren't there to show you we're learned or well read. Nor are they there simply to blame somebody else for our declarative sentences (as in "Don't blame us if we're wrong, blame them"). They're there to identify contextual links between TNT and lower level and lateral cognitive theories, other disciplines, and real-world issues. The same with the essays themselves; every one of them is about the contextual fit between TNT and other theories, disciplines, or real-world issues.

Two examples: Consider two papers we recently came across that provide the kind of lateral support discussed above. The first is about a concept in computational neurology called *predictive processing*. As described by Miller and White (2021), "Predictive processing casts the brain as a "prediction engine" – something that's constantly attempting to predict the sensory signals it encounters in the world, and to minimize the discrepancy (called the "prediction error") between those predictions and the incoming signal. Over time, such systems build up a "generative model", a structured understanding of the statistical regularities in the environment that's used to generate predictions. This generative model is essentially a mental model of the world, including both immediate, task-specific

information, as well as longer-term information that constitutes a narrative sense of self. [Prediction errors are minimized by updating] the generative model to more accurately reflect the world, or [by bringing] the world better in line with [the] prediction. In this way, the brain forms part of an embodied predictive system that's always moving from uncertainty to certainty. By reducing potentially harmful surprises, it keeps us alive and well."

The contextual fit with TNT is readily apparent:

- Predictive processing's (PP's) generative model is parallel to TNT's prime image, although it is not clear that the internal structure and the prediction mechanism for the former are as clearly defined as they are for TNT. But the two are largely the same.
- PP is about prediction of sensory signals. TNT is about prediction of events, bundles of sensory signals. Otherwise, the underlying idea is largely the same.
- PP uses the discrepancies between predicted signals and sensed signals to revise its generative model. TNT uses discrepancies between expectations and what actually happens to revise the prime narrative (see Essay #5 for details). Again, the ideas are largely the same.
- PP's generative model consists of the statistical regularities in the environment. TNT's prime narrative consists of events structured by time and causation and connected by causal rules. In TNT, probability is merely a way of measuring uncertainty about the reliability of the causal rules; how much one can rely upon the expectations that the rules engender. The underlying ideas are largely the same.

So, insofar as PP is a successful theory, its similarity to TNT could allow TNT to claim the same success (and vice versa).

The second of our two examples is about the neurological foundations of cognitive beliefs. Seitz and Angel (2020) examined the neurological bases and correlates of belief formation and conclude that there are three kinds of beliefs.

- Empirical beliefs form instantly and are about perceptions of objects and belief that those objects are real—TNT simply calls this perception which is about how sensations are synthesized into events and given meaning and emotional content through causal connections with past events.

- Relational beliefs, also are formed instantly and are about relationships among perceived objects—TNT calls these relationships causal rules—the predictability of one event given knowledge of another event.
- Conceptual beliefs are not formed instantly and require language. These beliefs are narratives that ... "pertain to human-unique events including the sequences of sensory signals such as music and language-based information ... Humans are used to telling stories about their own and other people's past, their origins, and their goals, and their future after physical death" (p. 3). TNT calls these derived narratives.

As with the first illustration, evidence supporting this classification of beliefs could be used as lateral evidence for TNT.

PART II

CONTEXT

The two essays in Part II follow from the discussion about how to test higher level psychological theories that was advanced at the end of Essay #1. Recall that the main idea is that lateral contextual ties with other disciplines are themselves a form of supporting evidence for a theory. In the case of TNT, three relevant disciplines are neuroscience, evolutionary biology, and the mathematical description of natural processes. The many citations of neuroscience research cited throughout Essay #1 and the remainder of this book establish the required links with that discipline. Essay #2 will examine contextual ties with evolutionary biology and Essay #3 will do so with the mathematics that best describes large parts of the physical (and social) sciences, called group theory. Space limitations dictate that both of these essays merely scratch the surface of their respective topics. They each could be expanded into books of their own. But, perhaps they will at least give the essence of our contention that they provide contextual support for TNT.

But context is but one goal of the following essays. They also describe the evolutionary and mathematical foundations of narrative and TNT. Evolution within an environment that can be described mathematically implies that the mathematical structure of that environment shaped and is reflected in the evolutionary outcome. That is, narrative thought is the way it is because humans evolved within a world that is structured the way it is.

Essay #2:
Evolutionary Context of TNT

Humans are bilaterally symmetric, bimanous, bipedal quadrupods who are in the middle of the size range of living things on this planet. But that description, while seriously proposed as the best model for intelligent life in the universe (Howells, 1967) does not capture our best feature. Rather, what uniquely describes humans and what has made us dominant, is that we far exceed all other creatures in ability to conceive of the future and to act on that conception (which, of course, is what TNT is all about). This essay describes what we think was the course of evolution that made that possible.[1]

In *The Sun also Rises*, Ernest Hemmingway (1926) captured how we attained the ability to conceive of and manipulate the future: "Two ways: Gradually, and then suddenly." There, in fact, he was referring to how someone goes bankrupt, but it also fits our evolutionary history, and this kind of step-wise time sequence actually suggests a lot about the neural and evolutionary foundations of narrative thought.

Since the beginning, life on earth has had to come to terms with *space*, *time*, *permanence, and causality*.[2] Time and space define the stage upon which all else takes place. Permanence and causality define the objects and actions that occupy that stage. We think that growing sophistication about these four fundamentals of the habitat, beginning with primitive life forms up through the appearance of cognitively modern hunter-gathers, shaped the development, structure, and ultimate form of narrative thought. In what follows, we will briefly describe where humans came from, how they came

[1] Before we begin, we need a disclaimer. What follows is our informed hypotheses about the evolution of conditions conducive to the organization of experience in narrative form. Anthropologists can learn a good deal from an ancient skull (e.g., how brains changed physically as their owner's habitats changed) but they can't tell us much about what was in that brain and how it changed as the brain changed. Any story about function can use evolution as its backbone, but that doesn't say the flesh on those bones is necessarily accurate. That said, please let us say our piece and you can judge how much of it you want to believe.

[2] Permanence, also called constancy, means retention of identity under transformation, such as displacement in space or persistence in time.

to terms with space, time, permanence and causality, and how mastery of these four fundamentals furthered their growing cognitive capacity.[3]

A Short History of Humanity

In the roughly 4.5 billion-year history of Earth, the lineage that eventually would become humans showed up for only the last 2 million or so; a mere .0055 of the total. In the intervening thousands of millions of years, many highly successful life forms came into being; some, like dinosaurs, both came and went, but, even so, they successfully occupied the Earth for hundreds of millions of years. None, however, evidenced a wisp of the type of cognition that comes so easily to virtually every modern human. All of which means that there was no broad teleological push toward the future-oriented cognition that humans exhibit. Rather, human cognition appears to be distinctive, the result of contingent, closely coupled circumstances that are unlikely to occur on Earth again.

Constraints

Even when it appears to, evolution doesn't tend to produce wild deviance (although the platypus may be an argument against that statement). This is evidenced by the fact that humans' genetic code is shared, in varying degrees, by every living thing on this planet. For example, some 50% of the human genome is identical to that of fruit flies (which is what makes them convenient for research on genetic factors in many human diseases). Various other species are more obviously similar to us: Pigs in their heart structure, cats in their brains up to the cortical level, apes in their brains including the cortical level, etc. Primatologists sometimes refer to us as simply another species of chimpanzee because of the extreme genetic overlap.

A major reason for all of this similarity is that evolution is conservative. Once it chances upon a mechanism that works, it retains it and adapts it to new challenges, frequently challenges arising from changes in a little

[3] Of course, *they* didn't actually do this in any purposeful sense. It was simply an adaptation to those aspects of their habitat that challenged their well-being. A lot of those ancient creatures perished before their progeny had what it took to survive in what often were uncongenial habitats. So, please forgive us for sometimes talking as though evolution is a purposeful process. Of course, it isn't. But, life's evolution did have a trajectory; to get as far as fast as possible from the surrounding environmental matrix in which life originally emerged.

portion of some species' habitat. The principle is "retain and adapt" rather than "invent anew" for every new challenge.

Retain and adapt is economical but very constraining. It limits the new, perhaps odd-ball, mechanisms that could take evolution in more extreme directions (which, incidentally, is what creates the illusion of a teleological push, an underlying purpose, when we look back at how humans and other species have evolved.)[4]

Capturing Space

Very early primates, like so many other species, specialized in olfaction—chemical sensing. Smell was preeminently useful in detecting nearby food and potential mates in the dense habitat in which they lived. Of necessity, they had some appreciation of space, if only the area immediately adjacent to them, but it is likely that they were unaware of anything further away than they could smell it, so their sense of space didn't need to be very sophisticated.

But, well before eight million years ago, on the African continent before the divergence of apes and hominids, climate changes led to much of that dense jungle habitat gradually being replaced by forest, which favors creatures who can detect things at a distance—those who can see non-proximal food and potential mates, and who can move and perceive depth well enough to reach them. The result was the survival and flourishing of those with sufficient amounts of these abilities. And, as these survivors reproduced in their new forest habitat, there was a gradual improvement of visual abilities from one generation to another. Indeed, over time, enhanced vision took over brain regions that previously had been used for olfaction, reducing generalized primate dependence upon the sense of smell.

The result of all this was that, slowly—over another several million years—our proto-ancestors became forward-facing, vision-centric, and space-oriented. That is, they became suited to a life that required appreciation of space and movement in it, as well as ability to retain locations within it—which direction home is from here, where water or berries are, and so on. Our remote early ancestors had, in fact, begun to capture space and act upon it as a useful tool for survival.

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[4] An example of the effects of retain and adapt is provided by Khouailly (2009): Human hair and bird feathers have a common origin in reptile scales, some 300 million years ago. Which is to say, in terms of hair, humans still live within those ancient reptiles' genetic boundaries.

Before long (relatively speaking), geological change joined climate change to disrupt life as our ancestors knew it; a change so profound that it resulted in the divergence of apes and hominids. Major tectonic events sunk the region of Africa now known as the Great Rift Valley and raised the mountains on its west side. This and the general cooling of the Earth, resulted in the drying out of the valley and most of East Africa. The result was replacement of the thick forests in this area with open savannas—a transitional landscape.[5] Of the generalized primate forms across the African continent, those who lived west of the Great Rift, where habitat change was minimal and forests still prevailed, eventually evolved into apes. Those that lived east of the Rift, where forests were replaced by savannas, eventually evolved into hominids, among them our own hominine ancestors.[6] For the most part, the Western apes stayed where they were. But, over time, the Eastern hominids spread successfully beyond savannas into less salubrious habitats, developing tools, including use of fire, which allowed them to leverage those habitats' favorable features and protect themselves against the less favorable ones.

Several different lineages of hominids emerged from this long tectonic and climatic transition. By about 2.5 million years ago, this biogeographic transition was fairly complete, and a general cooling of the Earth had also served to dry out East Africa. There is a rather contentious debate about how the human species became differentiated from the other hominines toward the end of the Pleistocene, largely because the developing lines of evolving humankind are, quite frankly, a bushy mess. But one thing is certain: Modern humans are creatures of savannas, drought, and sunlight—and of the need to travel across those hot, dry areas, and beyond, in search of water, food, and shelter.

Studies of ancient skulls suggest that advances in our ancestor's brains occurred in stages: The first major spurt was around two million years ago and the second around seven hundred thousand years ago. The first was the largest advance, with the hominine brain almost doubling in size. This growth occurred primarily in those areas of the brain that deal with visual processing and elaborate motor movements. This is consistent with hominines (hominids in our ancestral lineage) wandering beyond the savannas, traveling vast distances, encountering different climates and landscapes, while learning to make and use tools and beginning to form social units for cooperation in child care, hunting, food preparation, and

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[5] This, in turn, created pressure for even better vision in order to successfully exploit this new, open habitat.

[19] The role all this played in the evolution of our ancestors is sometimes referred to as the "East Side Story" Coppens (1994).

other tasks. This was when they began to more deliberately and directly "act upon" useful features of their habitats in their attempts to flourish—e.g., creating a stone axe by chipping away repeatedly at a found piece of granite, flint or chert core until a pointed tip emerged. But these earliest stone tools at different locations have a peculiar aspect: They appear to have been fashioned, used once, and then abandoned. It is as if their makers had enough intelligence to fashion them and to use them, but not to keep them for later use. We think this is an important indicator of an early form of narrative thought, because it displays a base structural invariant of the narrative form, but no other. That invariant is called a "translation operation"—repeat something until an outcome is accomplished, then move on. That's it.

Humans' first steps to higher intelligence were thus taken quite literally as Homo Erectus, manually and bipedally from about 1.6 million years ago to around 250,000 years ago. This was an intelligence of "acting on things." Quite simply, those who could exploit features of their new, ever-changing habitats survived and flourished, prompting further brain evolution.

The second expansion of the brain that we mentioned above, occurred about .7 million years ago and resulted in a roughly 75% increase in the size of the frontal and temporal lobes. The loci of these increases suggest they coincide with the beginnings of enhanced cognition, certainly more elaborate tool use, and, perhaps, language. It is possible that this second, focal brain size increase was prompted by, or accompanied, the forming of what TNT calls the "narrative urge" (Beach Bissell, & Wise, 2016). The latter is another fundamental structural invariant that somehow became added to our emerging conceptual toolkit. This is the one that allowed a stepwise set of transformations of an object into a recognizable new form, but a form that met the original intent. It closed back upon itself after going through distinct intermediary changes. It captured and closed the sequence in time that enabled it, extending "closure under transformation" (see Essay #3) into an effective projective cognitive tool. This new tool was going to enable the first mass human diaspora out of Africa.

The result of these two brain/cognitive expansions was that early humans increasingly became capable of manipulating their physical and social habitats to enhance their own and their conspecifics' survival. But, of course, this also required the capacity to learn and to retain what was learned, to differentiate the past from the present, and to anticipate the future. The acquisition of what we call narrative thought is only a step or two above this, and incorporates progressively less of the experienced structure of our physical environment, and more of the derived structure

acquired from ways of acting on or engaging with that environment (including our fellow humans).

With a generalized, wide ranging species like ourselves, the important perceptual linkage is not with precisely how specific things change, but rather with how they *stay the same* while undergoing change in appearance and perspective. This is the essence of cognitively "acting on things." We induce alterations in objects, in their appearance or function, and yet we still see them as possessing a unique and lasting identity. A stone hand axe becomes conserved over time because its future use can be foreseen; take it with you, refine it, and use it again. Gestalt psychologists recognized this, but never carried it beyond perception. TNT does, because it recognizes that the underlying structure of narrative is the same type that keeps the perceptual world invariant as one moves through it and engages with its features—i.e., with physical reality. This includes scale changes, such as when something distant from you moves closer to you or you to it; the entire pattern of activation on your retinas change. But you experience this as approach and withdrawal with respect to a constant object, not a cacophony of visual movement. Similarly, when you have a coherent narrative, you can focus on emergent details, or a story within a story, without losing sight of the "big picture" that is the inclusive narrative itself.[7]

The perceptual theory in psychology that has most successfully grasped the kinds of phenomena evidenced by your visual systems and predicted where and when spatial illusions will appear is called "General Constancy Theory" (Day, 1972). It states that "Any stimulus which serves to maintain perceptual constancy of a property of an object as the visual representation of that property varies will, when independently manipulated with the retinal image not varied, produce an illusion." Even cast in the parlance of an outdated "stimulus-response" theoretical framework, this expression reveals the first glimmers of eventual narrative thought in its essential insight: The maintenance of your constructed visual world depends upon controlled quantities that are maintained in neural feedback loops from the retina inwards. When part of any loop is specifically disrupted, the constancy of your visual world falls apart in precisely predictable ways. You do not recreate your visual world, you maintain constant your sensed experiences of it in order to *predict what will happen next*. As our early hominin ancestors left the relative sameness of a heavily forested world to enter the expanding transitional African savannas, their greatest need was to maintain a coherent perceived world under their own and externally initiated environmental changes. Once this became established in that first

[7] We explore this more in Essay #3.

great expansion of cortical mechanisms about two million years ago, the funneled groundwork had been laid for a second-step cortical enhancement that would eventuate in narrative thought. This was the visual system capturing space. Narrative thought would capture time.

Capturing Time

Like space, time has always been a significant part of the natural habitat. And, as a result, it always has been a factor in almost every creature's existence. From the beginning, time played a role in the evolution of animals' nervous systems. The result is that, today, many animals, including humans, are exquisitely sensitive to timing information (Levitin, 2014). Among other things, it is key to localizing a sound source using timing differences in the sound reaching the two ears, and for the integration of changing visual information attained through saccadic sweeps of the eyes. But, contrary to what is broadly believed, this isn't to produce a "mental model" of the habitat, it is to detect the temporal/spatial invariants in the habitat that allow prediction of how that habitat will change in the next few moments. If these predictions are correct, the perceived world is assumed to be as it appears and the rules for prediction are assumed to be correct.[8] To assist in this, there are "time neurons" in the hippocampus (cf. Gilmore, et. al, 2020, Reddy, et al., 2021) that operate in concert with separate spatial neurons, linking "when" with "where".

Time also was key when the human brain evolved to include language, which engaged cortical time-based encoding to track and process speech. This mechanism is particularly attuned to an individual's native language, as a result of early developmental exposure.[9] Moreover, this mechanism is only for speech and no other sounds—such as those from the habitat, or even music or laughter (Nora, et al., 2020). Processing of these other sounds makes do with time-averaging, where the sounds are analyzed as a whole. Speech processing is different and relies on that time-based cortical mechanism to bind segments of utterance to segments of time [which is reflected in how phrasing in music is processed (Hansen, Kragness, Vuust, et al., 2021)]. Indeed, it is for good reason that Wilhelm Wundt's *Principles of Physiological Psychology* (1873), an epic construction of human psychology, begins with an analysis of rhythm.

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[8] Looking ahead a bit, this whole process is 'retained and adapted' in narrative inferences about the future.

[9] For the tragic example of an early (13th century) experiment on what happens when infants are denied exposure to speech, see page 146 of A New Theory of Mind (Beach, Bissel, & Wise, 2016.)

Reliance on time is what allows the brain to encode the same words (and their meaning) even though they are spoken by different speakers with different intonations and modalities—i.e. sonic transforms that leave meaning invariant. All of those changes in spoken language are acceptable transforms that keep the meaning of the uttered words constant. Dean Buonomano, in his book *Your Brain is a Time Machine* (2017) argues that the brain's ability to "mental time travel" through its simulations of past and future events (memory and foresight) are what essentially make us human. We agree, although our focus on the binding and manipulation of time in TNT is less ambitious than the views of Professor Buonomano. To us, TNT unfolds from binding and structuring through acting on operationally closed segments of time.

Some other theorists have recognized the fundamental importance of time as underlying human cognition. Primary among them is the philosopher and semanticist, Alfred Korzybski, who, between 1920 and 1950 devoted much effort to examining the implications of what he called "Time Binding" as the essential aspect of what makes humans, human. Plants bound chemicals, and animals bound space, but we humans had somehow learned to bind time.

Korzybski's concept of "time-binding" lacked the needed neural underpinning that now exist, and it was mostly focused backwards, toward memory and all that collective history brought with it. It also lacked the group theoretic mathematical basis we gave it in our third essay. But it was an astounding insight given the state of psychology at the time. Without being able to closely describe *how* it was done, he recognized that if a generative (cognitive) system could bind a time-based segment that produced an output, and then structure within that segment, it would enable language and all that followed from it. Neuroscience has now begun to do just that, as demonstrated in the work of Nora, et al. (2020) on how the brain uses a cortical "time-locked" encoding mechanism to track and process speech. Speech is different from other sounds, and our perception of it relies on a specific time-locked cortical mechanism, where a segment of utterance is "locked" via a segment of time. This reliance on time is what allows the brain to encode the same words (and their meaning) even though they are spoken by different speakers with different accents—i.e. sonic transforms that leave meaning invariant. All of those changes in spoken language are acceptable transforms that keep the meaning of the uttered words the same to our understanding. And this is a key clue to the group theoretic mathematics that underlie these observations.

This "time binding" or "time locking" that enables language formation in spoken utterances is the "*…then suddenly"* in the Hemmingway quote at

the beginning of this essay. The capturing of time that allowed language and created narrative thought began in the same ways that space was captured by hominine voyaging through it and acting on it via handheld tools and weapons that could be thrown. But binding and capturing the time domain, not just being subservient to it, was both the figurative and literal "great leap forward" that Homo needed to complete the transition into a modern human. All of this within that last half million years or so of our heritage that was evidenced in the expansion of our frontal-temporal lobes to what they are today.

It was this final cognitive leap, not a scalar one that sized us right in the middle range of animals, so that we could live long enough but not too long, not a biomechanical leap like upright walking to take us vast distances, or even a visual leap like forward facing eyes with a 50% crossing in the optic chiasma to give us full 3D vision. But, all of those together set the stage that became the "grundlagen" for all that we were to accomplish and aspire to as story-telling animals, feet firmly on the Earth, heads in the stars, living in the imagined worlds we construct for ourselves.

Capturing Permanence

So, space and time provide the stage upon which permanent objects (both things and other creatures) are the players. But, this requires that objects be discernable, distinct, and enduring. That is, they must have a unique identity and be permanent. Without identity, every feature of the habitat would blend into everything else. Without permanence, every feature would be unfamiliar from one encounter to the next and what is known about it from previous encounters could not be applied to this encounter. It would be impossible to learn from experience, to build a store of rules for using objects to exploit the habitat for food, shelter, and reproduction. In short, although it may look different or move around in space and time, the object must remain a permanent, enduring entity; "closed under transformation" in mathematical terms.

But any stage play metaphor implies a passive audience, and this is wrong. To play their part in things, (i.e., survival) both early and modern humans move around in their habitat, interact with the objects in that habitat, and use(d) the consistencies they encounter to their advantage. This requires reconciliation between what their sense organs present and what they've captured about space and time. The product of this reconciliation is called *perceptual constancy*—which is but permanence by another name.

Consider an example we've used before; what happens on your retinas when you approach an object or it approaches you? Either way, the retinal

image of the object gets larger. But reconciliation prevents it from appearing to expand. Instead, it appears to be of constant size getting nearer—where nearer or further is inferred from the disparities between the object's images on your two retinas. That is, the perceptual system presumes permanence and attributes expansion of the image to movement in the three-dimensional space that is your habitat—either you are moving (which your muscles could confirm) or the object is.

Similarly, an object viewed from a variety of angles as you move around it or turn it in your hands produces substantial changes in your visual and haptic senses, but it remains the same object. Furthermore, if an object that is moving from right to left becomes temporarily occluded, you direct your eyes to the spot it should reappear—you don't assume that it ceases to exist simply because you can't see it. Finally, if you put an object somewhere, it is the same object when you retrieve it, it didn't cease to exist or become something else simply because it was out of sight as you moved around your habitat.

All of these examples are of *object invariance*, or *object constancy*. Under translational and other changes, the object (or you) moves in space and/or time—the "translational and rotational invariances" discussed in Essay #3. For vision, constancy depends upon neural feedback loops from the retina inwards. If part of any loop is disrupted, the constancy of the visual world falls apart, producing illusions—which, as Day (1972) determined, are lapses in permanence. Fortunately, in everyday experience, these lapses are brief enough that they aren't particularly disruptive. But they demonstrate the fragility of permanence and our perceived realities.

Capturing Causality

If capturing space and time provided the stage and capturing permanence provided the players, capturing causality provided the action. Povinelli and Bering (2002) suggest that a key advance in hominin cognitive evolution was the development of "a new representational system", enabling our ancestors to "reinterpret" the observable world by referencing unobservable ...causes". TNT, in turn, suggests that the new system, at least the foundation for it, was the ability to structure experience in terms of what-to-expect and what-to-do rules (Essay #1) and the unobservable was causality itself.[10] That is, what-to-expect and what-to-do rules are operational definitions of causality that require no real appreciation of what causality is; they work

[10] Although Povinelli and Bering probably meant hidden causes rather than causality itself, it doesn't negate our observations.

quite well as simple recipes for expecting and acting. But causality is why they work. And, for most of human history the recipes sufficed; nobody asked why they worked, they just accepted that they did. In this, causality is not unlike gravity—so commonplace that, until Newton, it just was. But, like Newton, someone thought about the rules, imagined some sort of force or something connecting the cause and the effect, and called it "causality".

The long line of causality's many Newtons began with Plato and Aristotle in early Western thought, and later included Hume and others, but the point is that once the rules for expectations and actions existed, the natural next question was what made them work. Invisible, hypothetical (but generally reliable) "causality" provided a sufficient answer—certainly as sufficient as gravity is for why things fall. Philosophers' efforts to the contrary, even today, arguments continue about what causality actually is, relying for the most part upon demonstrations of what it does instead of what it is—another parallel with gravity.

Fortunately, there's no need to understand what causality is in order to take advantage of it. Indeed, the fact that very early lifeforms survived long enough to produce progeny in sometimes hostile habitats, implies that reliance on the rules started very long ago, perhaps with simple reflexes and taxies—automatic responses to specific sensations and bundles of sensations. Reflexes have always been essential to the maintenance of creatures' well-being. Moreover, they can be chained together to give a pretty convincing simulacrum of a creature acting with purpose and foresight. It is only when an experimenter interrupts the sequence by changing some simple but critical environmental element to stop the sequence that the crucial reliance on external conditions is revealed.

The fundamental importance of acquired reflexes is illustrated by the readiness of most creatures to avoid food and drink that previously made them sick. We all know people who became averse to a food that once gave them stomach problems—the two of us know a woman who won't eat French Onion Soup some 40 years after doing so resulted in two days of severe gastric distress. One of us won't eat fish sticks from a similar experience 65 years ago. Scientific study of acquired food aversion began in the 1950's when Dr. John Garcia and his colleagues (Garcia, Kimeldorf, & Koelling, 1955) were studying the effects of radiation on rats. The researchers noticed that many of the rats refused to eat or drink anything they had consumed right before being irradiated (which frequently produces stomach upset). So, the researchers did an experiment: They gave sugar water (which rats normally like) to one group of rats, followed by no radiation. Another group got sugar water followed by mild radiation. And, a third group got sugar water followed by strong radiation. Later, when

given a choice between sugar water and regular water, 80% of the no radiation group chose sugar water, but just 40% of the mild radiation group chose it, and only 10% of the strong radiation group chose it. Clearly rats "inferred" that stomach upset was caused by sugar water (rather than invisible radiation) and wanted nothing more to do with it. They had learned what-to-expect if they drank sugar water (stomach upset) as well as what-to-do about it (drink the ordinary water instead).[11] Our point is that both innate and acquired reflexive aversions are causal rules for anticipating bad outcomes. And because acquisition occurs so readily for anything related to food and stomach upset, which presumably have been issues since the beginning, they suggest that causal rules have been around for a very long time.

Much of the evolutionary research on the capture of causality focuses on the rise of tool use as cognition became more modern. This is largely dictated by the anthropological record, which is rich in tools—axes, containers, grinders, combs, and so on (e.g., Stuart-Fox, 2015; Gardenfors & Lombard, 2018). The general conclusion is that human cognitive elaboration was accompanied by an elaboration in the invention and use of technology. That is, the history of humanity is a history of the tools it uses to cause advantageous changes in the habitat, to 'act on things.'

An idea of how much human appreciation of causality advanced after parting ways with apes around eight million years ago is provided by comparing the two today. Stuart-Fox (2015) sums it up: "... the capacity for causal reasoning in chimpanzees [12] is not much greater than in rats or corvids...", which, incidentally, isn't all that bad until you compare it with humans'. Indeed, humans, but not apes, rats, or corvids, understand that causes and effects need not be proximal. For example, sex causes babies, but not instantaneously and not reliably. Dunsworth and Buchanan (2017), note that, "Understanding where babies come from can't simply be observed. It requires grasping that a rather routine activity will have long-term consequences in the future—connecting a long-ago act to the resultant baby mice, kittens, gorillas or newborn whales and elephants born 20 days,

[11] Other researchers have extended these findings to such things as acquired food aversion in humans as a factor in anorexia (Bernstein & Barson, 1985), use of induced aversion in humans to various drugs (including alcohol and tobacco) in the treatment of addiction (citation needed), and to prevent childhood cancer patients from developing aversions to their normal food because of their treatment, by supplying an exotic food to which the aversion can 'become attached' (Bernstein & Treener, 1985).

[12] Chimpanzees, specifically Bonobos, are the apes closest to modern humans genetically.

two months, eight months, or almost two *years* later. Among the few of us, including bonobos, that copulate while pregnant—which can shrink the time between cause and effect—being able to link the business and substance of sex to pregnancy and its outcome would still take the kind of wild imagination that only humans ... possess. That, plus language, helps us to think these sorts of abstract [thoughts] and to communicate them. Once we're a few years old, humans begin to explain the unobservable. Soon thereafter, we're weaving and repeating stories about where babies come from. And it is not much longer until we're seasoned gossips ... ." And that gossip is always about causality—what happened in the past that caused the present, and what that will cause in the future. In short, the narrative form.

Afterword

Narrative, specifically the prime narrative, is the nexus of captured space, time, permanence, and causality in a structural form literally taken up from the natural world humans evolved in. Which is to say, everything that happens to you, every segment of your ongoing experience, involves permanent objects located in space and time and linked to other segments by causal rules.

ESSAY #3:
MATHEMATICAL CONTEXT OF TNT

Albert Einstein (1936) observed, *"The eternal mystery of the world is its comprehensibility."* This essay will address how humans—through the stories they tell themselves and others—have come to ascertain, apparently correctly, the structure of broad swaths of nature as well as their own place in it. Quite simply, they can do it because human thought (TNT) and nature writ broadly have the same underlying mathematical structure and that structure is described by Group Theory.

Our discussion will proceed in four steps: First, we provide a (necessarily brief) non-technical overview of group theory. Second, we note some isomorphisms between the structures of narrative in general, TNT in specific, and group theory as it is applied in the natural sciences. Third, we note some of the ways in which group theory shows up elsewhere in psychology. Finally, we look at the implications of having the mathematics that best describes the structure of the physical world also being the best description of the structure of narrative cognition.

Group Theory

On the assumption that you may not be familiar with group theory, or are a little rusty, the following is to give you the general idea or to jog your memory.[1]

Starting with a collection of elements and the goal of deciding if the collection constitutes a "group" in the group theory sense, group theory defines the required outcomes of various operations on those elements. The idea is that scientific domains that are describable as groups within which operations and their allowed results are in fact observed, are logically (mathematically) related to other domains in which these conditions hold.

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[1] J. H. Newman (1956) provided a clever description, "The theory of groups is a branch of mathematics in which one does something to something and then compares the result with the result obtained from doing the same thing to something else, or something else to the same thing" (p. 1534).

Mathematically, there are only four requirements to have a group structure:

- For every pair of elements in a group, their product always is in the group. This is the law of *association*.
- Combining a set of elements in a group in different ways always produces an element in the group. This is called the law of *composition* (Lentin, 1971).
- There exists an identity element for the group such that combining it with any other element always yields the other element. This is called the *identity operation* (Lentin, 1971).
- Every element in a group has an inverse, a reciprocal, element in the group, such that combining the two elements always produces the identity element. This is called the *inverse operation* (Lentin, 1971).

A collection of elements that fulfills these requirements qualifies as a group structure, which then permits other statements about them consistent with this group structure.

Group Theory in the Sciences

Group structure shows up everywhere, especially in the physical sciences but also in the social and biological sciences, the humanities, and the arts and literature and even religious studies. It has been called the "core of mathematics." F. Le Lionnais, in his edited *Great Currents of Mathematical Thought* (1971), states that "The great generality of this conception (i.e., group) allows it to play a role in the most varied areas of mathematics, to relate their existence and mechanism to the structure of the human mind, perhaps even to the very architecture of the universe." (p. 201)

The principles of group theory have been expressed in many ways (see Lipka et al., 2019), but its first mathematical formalization (in 1832) was provided by a 20-year old Frenchman named Evariste Galois, who completed it the night before he died in a duel.[2] His work was not published

[2] His short life was tragic. He was a brilliant, but troubled, young man, caught up in the fervor of revolutionary French politics. But the duel was over a woman with whom he had fallen in love, but who did not return his affections--although, there is some suggestion that she may have encouraged his attentions and her fiancé's jealousy to prod that man toward marrying her. If so, she succeeded in the jealousy part of her plan, but at a cost far greater than she may have realized; Galois' genius was lost to the world.

until 1846, 14 years after his death, and for the next half century it was considered too abstruse to be of any practical value.

This verdict remained even after group theory was successfully used, in the late 19th century, for the unification of geometries. Felix Klein's *Erlanger Programm*, re-expressed different geometries in terms of group theory, showing which properties of figures each type of geometry preserved. (Trkovska, 2007). Klein's work provided a glimpse of the immense power of describing constancies across theories in group theoretic terms.

In 1905, Albert Einstein used group theory, specifically the Lorentz Group, to derive his first theory of Special Relativity, and mathematically inclined scientists around the world began to take a closer look. Today, group theory is widely regarded as the foundation of all the physical sciences and, as Switchtenberg (2015) has shown, all laws in physics rely on it.[3] Similarly, in chemistry, the periodic table makes no sense without it.

Sadly, no one has yet written a "nutshell" guide for group theory in the social and behavioral sciences, although mathematicians keep discovering and describing its role in other realms of human endeavor, including the arts, architecture, and design. For example, Mehaffy (2020) extensively described how incorporating the modern mathematical symmetry concept in architecture and urbanism leads to an entirely new "research agenda" for these disciplines.

Perhaps the best introduction to all of this for the beginner is through the appreciation of *symmetry*, which is the visual expression of group theory. The best introduction is still Herman Weyl's (1952) elegant book, *Symmetry*, which is now available for free download on the Web. Another excellent source is the less mathematical *Symmetry: A Unifying Concept,* by Istvan and Magdolna Hargittai (1994). Both of these volumes show how the concept and expression of symmetry in all of its manifestations literally underlies all human endeavor as well as the deep structure of the natural world.

Group Theory in Narrative

Let us consider the fundamental structure of narratives, any narrative, not exclusively TNT or its prime narrative, and how various aspects of this structure correspond to group theoretical concepts.

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[3] See A. Zee's (2016) very readable *Group theory in a Nutshell for Physicists*, Princeton U. Press, to see how the theory provides theoretical foundations from quantum through particle physics to cosmology.

- A narrative unfolds from a beginning and is both temporally and causally sequenced; its "story line." Which is to say, it transitions through time while remaining *the same narrative.* It also has an ending (or, if not, its continuation is signaled in the narrative). In group theory, the property of changing while staying the same is "translational invariance." In perceptual psychology, for example, such invariance is revealed in the phenomenon called "object invariance".
- A narrative includes within it some events or descriptions and excludes others, because "they are not part of the story." Inclusion of superficial elements or irrelevancies are experienced as incoherent or "padded". In group theoretical terms coherence is provided by "closure under transformation", where some narrative actions (transformations) are allowed in as needed for exposition of the story line, and other actions and their resultant details are left out because they do not fit the storyline's temporal or causal sequence. In group theory, those allowable actions (transformations) are either in or out because they preserve key properties of the mathematical expression—the constant form of a geometrical figure, or the solution of a particular equation. We'll further explore "closure under transformation" below.
- A narrative contains elements or components or descriptors at different levels of detail (scale). There are details at the small end of the scale, and "narrative arcs" at the large end. And yet, they are all part of the same narrative, large and small. And a "good" narrative has the proper mixture of elements across the entire scalar range. In group theory, this ability to have the same result or property when actions are taken at different levels of scale (such as transforming the mathematical expression from, say, millimeters, to meters, to kilometers) is called "scale invariance". Scale invariance is a fundamental aspect of basic laws in physics, statistics and biology, as well as narrative. Things have to make sense, have to fit together at different levels of scale in order to be coherent, a fundamental property of both mathematics and narrative.
- A narrative usually has a distinct end and attaining that end is often the reason for the narrative. A goal is reached, a crime is solved, a meal is prepared, two lovers are reunited, a tragedy is forestalled, a coming of age is attained. The end of the narrative can come about in any number of ways but always refers back to the beginning of the narrative and what launched it. Narratives that simply stop are unsatisfactory. They not only must be "closed under transformation"

by containing only the right parts, but all of those parts must also come around to referring back to the beginning, binding it into a coherent and efficient temporal/causal sequence. In mathematics, the sequence of change that reaches back to an earlier state is called being bound into a group structure, and displays, in visual form at least, what is called "rotational invariance".

- Finally, narratives are predominately composed of oppositional relationships: Up / Down, Good /Bad, In / Out, Right / Wrong, Light / Dark, etc., etc. This is often referred to as "Polar Typology" in human thought processes (Penn & Mysterud, 2017). Indeed, human thought relies so heavily on oppositional constructs that it is difficult to imagine it taking place without them. In group theory, these oppositions are called "reflection" operations or invariances. This is often visually experienced as "symmetry", but that term implies something so much more basic in mathematics that we'll focus for the moment only on one type of symmetry, a reflection operation.
    - A reflection operation is actually a "bounce back" within some type of defined closed set of operations. As an example, look at yourself in a mirror. Move your hand up or down, towards or away from the mirror. Note what is happening: Your actions are "bouncing back" to you in a very straightforward way. And this is not at all in the same way as if you were to turn 180 degrees around and then perform the same actions. Try it. Hold your right hand out in front of you, and extend your left hand behind you. Then rotate your body half way around so that you would be facing yourself. Do you look as you did in the mirror? No. If you held out your right arm to begin with, it would still be your right arm throughout the rotation. But in your mirror image, the extended arm forward is on the *left*, the original backwards left arm has now become your *right*! Your image in the mirror has "bounced back", and in doing so been discontinuously altered in a reflection operation from the mirror surface.[4]

[4] This crucial distinction between continuous changes, like rotations, that bring forms or states into apparent opposition with themselves, and reflection operations, which do so immediately and discontinuously, is at the heart of many misunderstandings in human affairs. The oriental concepts of Yin and Yang for example, are not opposites in the sense of a reflection operation. They continuously rotate into and become each other over time. The prominence of conceptual oriental rotational "opposition" vs western reflection "opposition" is at the heart of many unfortunate conflicts over the centuries. The history of the protracted debate over the shape of the negotiating table to end the Vietnam War is but one of these.

The foregoing are the fundamental properties of their structure that keep a narrative a narrative, and corresponding concepts in group theory. The former is expressed in words, conceptually, and the latter is expressed in symbols, mathematically. But the point is that they reflect the same set of structural operations and that this ties narrative, both narrative in general as well as its specifics in TNT, to the larger body of science in which group theory is a useful and ubiquitous descriptor, thus providing a form of support for the theory that corresponds to the discussion at the end of Essay #1.

Group Theory Elsewhere in Psychology

Although most psychologists don't realize it, group theory is already widely applied in psychology:

- **Acting on Things**: The core insight of group theory for psychologists is that the structure of anything is not to be discerned by analyzing the thing in itself (the "*Ding an sich*", as Kant put it), but by looking at the results of *acting on it*, particularly in ways that do not disturb or distort it. For example, if the criterion is to not disturb the space around a drawn geometric figure, then the question is how many ways one could transform (act on) the figure and not disturb or distort its surrounding space. The answer depends on the figure, but if that figure is a two-dimensional rectangle, for example, there are only four such transformations allowable under group theory. You could flip the rectangle both horizontally and vertically so that it aligns perfectly with itself. You could rotate it by 180 degrees (either way is the same.) into correspondence with itself. And, most critically, you could simply map the rectangle back into itself, preserving its identity. Those four transformations are special ones. In mathematics they are called "automorphisms"—self mappings—and comprise what is called the Group of the Rectangle in this particular instance. But that same group structure can appear in many other ways besides expression as a group of allowable "self-mappings" of a rectangular geometric figure. It has been found in kinship recognition and marriage laws, as well as the structure of a 2 x 2 analysis of variance, and other human theoretical systems.[5] They all have the same

[5] For example, the definition of sustainability provided by The Natural Step. (See their website, https://thenaturalstep.org/approach/)

underlying group structure, all identical to (isomorphic with) that of the rectangle.

- **Language and Group Structure**: Compare the meaning of the sentence, "They are drinking beers" with the meaning of another, "They are drinking glasses,". These sentences all sound remarkably alike, and yet their meanings are very different. How many ways could you change (transform) the sentences, while preserving their meaning? In a first case, you could change them to the passive voice, "It is beers they are drinking." But this transform is not allowed in the second or the third cases, where the passive sentence "It is glasses they are drinking" makes no sense. Also, you could change each sentence into a question. "Are they drinking beers?" and "Are they drinking glasses?", which are both allowable. But again, asking passively "Is it beers they are drinking?" makes sense, while "Is it glasses they are drinking?" does not. As Z. Harris (1969) writes, "…it is useful to view language as a set of sentences with a set of allowable transformations of those sentences" (p. 195). What follows from this kind of view is a group theoretic formalism of language structure and comprehension.

  So, this fundamental idea of the structure of something, be it a geometrical figure or the meaning of a sentence, is not tied to the thing as you see it or read or hear it at a given moment. Rather, it is tied to an allowable set of transformations–of ways of "acting on" it, that you come to know and accept. You may have to learn those allowable transformations through visual or spoken experience, but the most basic mechanisms of perception and thought rely upon them. This is what we are proposing as the integral meaning of TNT's prime narrative, its coherence, and the meaning and coherence of narrative thought itself.
- **The Identity Transformation**: This means that whatever the group is about, must map back into itself in a unitary transform. In mathematics this operation can take many forms, depending on the set being operated on *in a specific way*. For example, the number zero (0) becomes the identity element for the set of natural numbers under the operation (acting on) of "addition". The number "1', unity, becomes the "identity operation" for that same set of natural numbers under the operation of "multiplication".[6]

[6] What seems obvious to us today actually took centuries to understand, largely by Arab thinkers after the ancient Greeks' mostly geometric forays into mathematics.

But in psychology, if we are proposing a group theoretic basis to narrative thought, the identity transform assumes a distinct prominence and requires some examination. The equivalent of the Identity Transform in human cognition and TNT is the acquisition of self-awareness, the personal realization that each of us holds that we are an independent, acting being; a self-identity. In the final essay in this book, Essay #17, we discuss the "formative I" and the "elaborated I", exploring how one's sense of self goes beyond pure identity and becomes constructed by the stories one creates about one's self. Here, examining the foundations of TNT, we align the identity transform of a group with the "formative I" of TNT, at least with the requirement that the "formative I" entails the coalescence of self-awareness to the achievement of being self-aware as a distinct being.

Rene Descartes famously began his *Meditations on First Philosophy* (1641), with "I am, I exist," changing it from his earlier, more quotable (1637) "I think, therefore I am." Either way, it is a recognition of the requirement of a base identity transform in human thought. TNT, on the other hand, turns all of this around to say: "I am; therefore, I think." This is because in TNT we see the foundation of thinking being provided by the prime narrative, which is the term TNT uses for the content and set of cognitive structuring operations that form the bedrock for the narrative self.

Descartes was not the only one to begin this way. The mathematician Andreas Speiser, (1971) writing in his *The Notion of Group and the Arts* essay, notes (page 170) that "Reality first reveals itself to us through ourselves: We know only the I, therefore the One." This sentiment recalls the primacy of the simple words, "I Am." in Judeo-Christian teaching, where God refers to himself that way, first in the Book of Genesis 15.1, and later when introducing himself to Moses (Exodus 3:14) with the words "I am who I am." Adding "Say this to the people of Israel: "*I am* has sent me to you."

All of this is to say that the awareness of self, of personal identity, is primary in human consciousness, and equivalent to the need for the identity transformation. Consequently, we propose an Identity Operation as one of the core Group Operations of Prime Narrative.

- **Closure under Transformation**, is another essential characteristic of both group theory and narrative thought. Lionnais (1971) expresses this succinctly: "The notion of group corresponds to a fundamental aspect of intellect: The aptitude for combining every new idea in every way possible with prior knowledge in such a way

as to exhaust the possibilities" (p. 201). This is closure under transformation. In group theoretic operations, it means that any action or combination of actions in the group will always lead us to another element in the group. You can't think in a way that you can never *unthink*. And in narrative thought, a set of actors and actions are causally bound in time, allowing you to be confident that you can project a plausible future from it because you have a complete grasp of the situation. You may be wrong, you often are. But, when a prediction error occurs, the latest research shows that it is the *saliency* of that unexpected outcome that generates a rewarding dopamine release, not just whether the outcome was good or bad for you (Kutlu et al. 2021). In other words, *if* what happened as a result of your action was not in the cognitive closure of things that should have happened given your actions, your nervous system rewards you to pay attention to it. In such a way, your forming derived narratives are extended, elaborated, and increased. You close around ideas and narratives by operating on them, are internally rewarded when surprise occurs, and then are motivated to continue the process. Surprisingly, it is exactly this group requirement for "closure under transformation" that led the mathematician Cassius Keyser (1956) to ask explicitly "Is mind a group?" (p. 1552) and then deny it, because he could not fathom how a mind could then grow and change. He was unaware of the work of Jean Piaget, who was then using group theory to show exactly how this occurred, in the growth of children's intellects.

Group theory and Jean Piaget

We would like to think that we are the first psychologists to discover the connection between narrative thought and group theory, but we have actually come to the same realization that Jean Piaget came to over a half century ago, working from the opposite direction. We worked downward by analyzing the structure of narrative thought. He worked upward, by watching how the growth of knowledge occurs in children's formative years. (Piaget (2012).

Many American psychologists have been taught that Piaget was a child psychologist, but he did not see himself that way. He called himself a "Genetic Epistemologist" and focused on the growth of knowledge in its grand sense, particularly Science. His famous research–conducted on his own children-was meant to be an illustrative example of how knowledge grows in human thought in general. And his theory was based on group

theory (although he called it a "Grouping" and its mathematical form was more like a lattice structure because he included translational and scale invariances in its complete formulation). But this mathematical basis was lost in the early English translations of his work that were taught and popularized in the United States where psychology was in the throes of Behaviorism (1940s-1960's).[7]

Besides Piaget's formalization, Group theory has had a long intersecting history with Psychology and other Social Sciences. We haven't space to review all of that, but we note a couple of others who have seen its importance in constructing a basic theory of human perception and thought. Ernst Cassirer (1944) writing about the same time as Piaget, made the argument for group theory in his *Concept of Group and the Theory of Perception.* He wrote, "Psychology dismisses the dogma of the strict one-to-one correspondence between physical stimuli and perceptions. It is, on the contrary, the "transformed" impression, i.e., the impression as modified with respect to the various phenomena of constancy, which is regarded as the "true" impression, since we can on these grounds *construct knowledge of reality*" (emphasis added). In other words, reality becomes what stays the same as we act upon it. In this he foresaw Day's (1972) General Constancy Theory, which was discussed in Essay #2.

Michael Leyton's (1992) *Symmetry, Causality, Mind* is another example of an investigator using symmetry (group) theory, time, and the recognition of causality to come to insights quite close to TNT. His assertion that internal principles of organization generate causal histories which then become memories and the basis for future actions sounds much like our prime and derived narratives. Both views are grounded in the central importance of time and group structure, although Leyton's is more concerned with the visual manifestation of symmetry. We, on the other hand, rely much more upon neuroscience finding, while he uses machine learning and computational algorithmic analogs. We are working from a viewpoint of the prime narrative as a replacement for the traditional concept of mind, while he is trying to build mind up from first computational procedures based on visual symmetries as a basic structural mechanism. His

[7] In some ways, Piaget's formulation on intelligence and knowledge in group theoretic terms is still best appreciated in its original French. We refer the reader to the analysis provided by the physicist who worked with Piaget, Jean Blaise Grize's (1960) chapter on "Du Groupement Au Nombre: Essai De Formalisation." An English version of Piaget's use of Group theory to form what he called a "Grouping" in Psychology is provided by Wittmann (1973). Piaget's use of the "Grouping" concept in Philosophy of Science is discussed in English by Tsou (2006).

work, coming toward the same target as our own, shows how differently the same mathematical (group) and physical (time) concepts can be treated by different investigators. We leave it to future inquirers to work out all the intersections.

Afterword

We began this essay with a quote by Albert Einstein expressing his astonishment at how the (group theoretic) mathematics of relativity could so successfully predict scientifically measurable minute physical phenomena. One of the earliest demonstrations of this was the bending of starlight from the distant Hyades cluster around the edge of the sun's disc as it was obscured during the total solar eclipse of May 29, 1919. Sir Arthur Edington, who performed one of the precise observations at a site in the Gulf of Guinea, was astounded. A couple of years later (1921) he wrote of this, and his keen understanding of what the group theory math beneath it really implied is worth repeating here. He observed:

> "The theory of relativity has passed in review the whole subject matter of physics. It has unified the great laws…….And yet, in regard to the nature of things, this knowledge is only an empty shell—a form of symbols. It is knowledge of structural form, and not knowledge of content. All through the physical world runs that unknown content, which must surely be the stuff of our consciousness….And moreover, we have found that where science as progressed the farthest, *the mind has but regained from nature that which the mind has put into nature."* (p. 68, emphasis added)

Remember, group theory is never about anything in and of itself. It is about "acting on things." And who is doing the acting? You are. You are choosing the actions to be done—the translations, rotations, reflections and scale changes–that create the mathematical integrity you then use to assess and measure the physical world. So, it is little wonder that you should in fact only "regain from nature that which (you) have put into nature." And what allows you to do this is that you have an intelligence that was itself honed by your species' long history of acting in and on nature, largely through sight and other physical manipulation. That is, all the translations, rotations and reflections that you use to act on things—like utterances, signals and symbols— are bound in the time domain. And when they are bound, they become amenable to operations—to actions on them—that are as useful as those direct physical ones that earlier operated on encountered physical reality itself.

In other words, you are where you are as a narratively thinking being, living in the stories you tell yourself, and yet able to describe and capture physical reality to a high degree of precision because the structured content of your experience (your prime narrative) has been appropriated directly from the structure of the world you live in. All of us have sensually, perceptually, and cognitively (as well as mathematically) extracted the structure of reality and used it, as Piaget has shown, to grow our own mental structures that then create and govern narrative thought.

As Essay 2 has shown, our species' particular path toward where we are now was surely a contingent one, relying on the vicissitudes of asteroid intervention and continental drift to bring hominids forth when and where they did. This raises the question of whether life on other worlds would come to an intelligence like ours, only via another contingent pathway. That the laws of physics appear to be universal would seem to suggest that at least from reality's side, this is a possibility. But such intelligences would also have to act on the encountered environments in similar ways as our own and on a similar time scale as our own to develop corresponding cognitive structural operations. Given how much solar radiation, lunar tides, gravity field and atmospheric composition shapes and constrains our interactions with the environment, it seems unlikely that such equivalent conditions would occur on other worlds. So, our own human intelligence and narrative thought may well be unique, or exceptionally rare in the universe. But this does not rule out other confluent structural pathways in the developing sensory/behavioral systems of other evolving organisms and their supportive environments. If these act analogously to "strange attractors" in dynamic systems, then correspondingly different schemes of "intelligence" may well arise. Just nothing like the narrative thought of our own.

PART III

THE FUTURE IN TNT

The first of the following three essays describes various ways of conceiving of the future and how one exerts influence on it. The second describes the implications of experienced past and present for the (predicted) future, how this sets expectations, and what happens when something else happens instead, i.e., when expectations were wrong. The third essay describes the nature of threats in the expected future.

ESSAY #4:
THEORIES OF THE FUTURE

TNT is about the future because virtually everything in life, including life itself, is about the future. This is paradoxical because the future doesn't actually exist—not yet. What is more, the past and present don't exist either—not anymore. The past has already happened. It lives only in records archived in people's memories, in books and films, etc., but, records are not the thing itself. The present exists only fleetingly, although it seems longer because the brain bundles a series of instants together to provide the illusion of duration. Actually, each instant is over almost before it began, and most of the brain's synthesis is almost instantly recorded in memory; again, different in substance from the instant itself. Although the archive can be corrupted, nothing can change what happened in the past or present, they both are over and done with.

This leaves the future, which, however real it may seem when you imagine it, exists only as *expectations* until it becomes the present. This is where it differs from the past and present; they are facts; it is potential. And this potentiality leaves open the opportunity for things to turn out differently from what is expected. That is, the actual future may not yet exist, but it will, in some form or other. The purpose of an individual's every action is, in effect, to manage the future, from the very next moment to far off in time. Doing this requires prediction of what will happen and acting to ensure that whatever actually happens is sustaining rather than damaging. Sustaining in that it supports survival—in the broadest sense of the term.[1] This is what we mean by everything in life being about the future. Everything you do, however minor (even hiccups and burps) is aimed at shaping the future, in making it conform to your values and preferences, at curtailing current threats, however minor, and preventing them from extending into the extended future as well as thwarting new ones before they happen. And, all those records of the past and fleeting present exist solely to inform expectations and guide mitigating action.

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[1] We use the word "survival" to encompass everything that enhances life, ranging from freedom from annoyances, through absence of discomfort, anguish, pain, or the agonies of death.

Conceptions of the Future

A great deal of energy has been expended on trying to understand and control the future. Although not always explicit, most of this effort rests on one of just a few assumptions, which we have divided into two classes, *chaos* and *orderly*, along with their respective variants:

A Chaotic World and Future

Chaos #1 holds that the world, and therefore the future, is disorderly, unpredictable, and outside the control of gods or humans because it lacks causality or any determinant form and therefore provides no purchase for influencing what the future will be.

Chaos #2 holds that the world is chaotic but, with limits, the future can be influenced:

Chaos #2a holds that the future can be influenced by a privileged agent—priest, god(s). This variant necessarily assumes some degree of causality in that it assumes that the actions of the agent has an effect on what happens.

Chaos #2b holds that ordinary people can influence the future, but only indirectly through the privileged agent(s).

An Orderly World and Future

Orderly #1 holds that events in the world, and therefore in the future, are foreordained and nothing will change them.

Orderly #2 holds that the future will inevitably unfold according to a preordained plan. But, the plan is assumed to have a transcendent author(s), the cause of its existence. And, having authored the plan, he, she, it, or they can change it.[2]

Orderly #2a holds that the future follows a plan attributable to one or more transcendent authors and humanity's job is to accept it as it unfolds.

Orderly #2b holds that the planned future is an unequal collaboration between the junior author (you) and the senior author(s) of the plan. That is, the future is the result of the junior author's actions playing out against the senior authors' plan. Changes in the plan may be made by the senior author(s), but the junior author can petition for change through prayers,

[2] Furnishing one, or more, author(s) is foundational to most formal religions and has driven the development of justifying philosophies, rituals, literatures, and behavioral codes that have shaped cultures.

sacrifices, devotion, penance etc. or by earning change as reward for good works or punishment for bad works. Much of Western thought reflects this unequal co-author conception of the future. It has long served important psychological and cultural purposes and, as such, deserves our attention as behavioral scientists. But, it requires *belief* in a preordained plan and an author(s) of that plan. And, it requires *confidence* that one's efforts can induce that author(s) to change the plan to accommodate one's own needs.

The requirement for belief and confidence implies that *doubt* is possible. Which invites the question: What if there is no plan or divine agent(s)? What then is the nature of the future and how then can it be controlled?

There are two answers to that question. The first is reflected in modern science: The future is foreordained because the world is deterministic and science's task is to discover how it works. Which is to say, the world is orderly (authorship usually nebulously attributed to "Nature", whatever that is), and operates according to discoverable causal rules that give order to the past and present and dictate the future. As the philosopher, David Hume (1748), reminds us, "The only immediate utility of all the sciences is to teach us how to control and regulate future events through their causes" (p. 56).

The other, noncompeting, answer to the question comes from TNT: The world is deterministic and each of us has to learn the pertinent rules in order to manipulate the future so we survive and, when feasible, prosper. Individual human's rules are not necessarily the same as those of science, even for the same phenomena. Individuals limit their causes and effects to events within their experience, where objects are solid and static, even though science tell us their molecules and atoms are constantly in motion and have space between them. Experience in which the sun appears to rise, even though science tell us it appears to do so because the earth revolves, where the moon appears larger on the horizon even though science tells us it is an illusion. The major difference is that science's habitat, its sphere of operation, extends from solar systems, galaxies, down to atoms and their components; ours is limited to the reach of our senses, even when we believe that there is more. Moreover, individual's rules are less precise than science's and usually are based on far less data. After all, the future is here and gone in an instant and a new future instantly presents itself. There is no time for precision, nor is there a need—action is an ongoing enterprise and can be adjusted in light of how well it is working. In our habitat, flexibility is more important than precision.

TNT is about individuals operating in their unique habitat(s). Its answer to the above question about the nature of the future, and how to control it, is that the future is largely up to each of us. Even if we believe in transcendent authors, we can't depend on them for everything. Our individual

habitats, our small parts of the world, are deterministic. In our world, there are reasons why things happen and if we can learn those reasons, we can prevent bad things and promote good things. The key is rules and action; learning what-causes-what so that specific effects can be expected to follow from performance of specific acts.

Having the ability to influence the future sounds like something from science fiction or an action comic. But it is precisely what you are attempting every time you do something--anything. You scratch your nose to prevent continued (i.e., future) itching, you cook your dinner to prevent future hunger, you pay your rent or mortgage to prevent future eviction, you take vitamin pills to prevent future illness, and so on. Stated baldly, *all action is aimed at changing the future so it conforms to the actor's standards, his or her values and preferences*. This is as true for seemingly trivial actions as it is for big things like going to college, taking a new job, or buying life insurance. All action is designed to make the future more desirable than it is otherwise expected to be.

Control of the future is exerted through active manipulation of the physical environment, which includes the shaping of sound while talking, the marks made with a pencil while writing, or pressure on computer keys while e-mailing. The entire system is a feedback control system. Humans' attempts to manipulate the future are an extension of, an adaptation of, the general feedback loop control system that emerged early in our evolutionary history, a system that governs much of our body's functioning. In TNT, the feedback loop guides action to keep experience within acceptable limits around one's standards—how things should be.

Afterword

We realize our dissection of theories of the future isn't very sophisticated, but we aren't philosophers. However, it serves to demonstrate that it is possible to think about the future in different ways and that these ways have different implications. Most important, though, is the nearly universal idea of an oncoming future that brings with it the possibility of threats. And, how evolution has provided a tool, the prime narrative, and its constituent causal rules, for glimpsing that future and exposing those threats. Equally important, it has provided tools, based upon those same rules, to manipulate the course of unfolding events so that the threats, when they get here, have been eliminated or diminished, turning them into opportunities to make things the way they should be—conforming to one's values and preferences. This is the essence of TNT.

ESSAY #5:
EXPERIENCE, EXPECTATIONS, AND ERRORS

This essay expands upon Essay #1's description of the origins of experience, how it leads to expectations about the future, and what happens if those expectations turn out to be wrong. The discussion is based upon our understanding of the brain's (actually, the entire nervous system's) ability to synthesize, link, and differentiate sensory inputs and stored experiences. Synthesizing produces the rich cognitive world that is so familiar. Linking provides the causal/temporal narrative structure that undergirds that cognitive world and sets expectations for the future. Discrimination allows appraisal of differences between expectations and what actually happens.

Experience

Everything you know, feel, remember, or expect to happen started as the firing of a sensory nerve in response to some aspect of a change in your internal or external habitat. Of course, the sensation of a single nerve firing doesn't convey much information about the change, but your brain has evolved to extract maximum information from everything that excites your senses. It begins by synthesizing *simultaneously* occurring sensations from within and across sense modalities into time indexed *events*. Each event says more about a possible habitat change than a single sensation can, but, because it represents a bounded instant in time, it is just a snapshot of what is taking place. So, the brain repeats the process, accumulating and synthesizing *successively* occurring events into larger, longer, more informative *episodes*.

Synthesizing assumes that temporal proximity (simultaneous or successive) contains information about the underlying environmental changes. For synthesized events, it treats temporal proximity as a link between component sensations and for synthesized episodes it treats it as a link between component events. Objectively, these links are simply co-occurrences. But the brain evolved in a causal world where events and episodes presaged other events and episodes. As a result, it is predisposed to interpret co-occurrence as causal. The result is that as synthesis proceeds from sensations to events to episodes, the brain leverages the temporal proximity of information-poor sensations into moderately rich information

about the underlying changes in your habitat that incorporate your own actions in it. It's a "feedback loop" of sensed informative changes bound by time and your acting on (and in) the world you inhabit.

It doesn't end there. Episodes may contain more information than events, but they are still not all that informative on their own. But, your brain retains a record of its work—sensations, events, and episodes are archived (called memory) by their respective time and causality, and the result is, *de facto*, one more level of informativeness—the remembered past and how it led to the perceived present—the foundation of narrative. Addition of the causally/temporally implied expected future results in the prime narrative (maintained under allowable changes) featured in TNT (Essay #1).

Before moving on, recall that the motivating force in TNT is the brain's urge, if you will, to synthesize, to produce coherent (closed) structures by bringing order to discrete elements. But, of course, we don't know precisely how that works. So, what follows is an "as if" description. That is, what the brain actually does is as if it were doing what we will describe—even though it probably reaches the same ends by a markedly more efficient path. (Another thing to recall; for convenience, we are using the umbrella term "event" for everything in the narrative past, present and future instead of repeating "sensations, events, episodes and expectations" every time we refer to narrative content.)

Expectations

The prime narrative's past is composed of previously experienced events, its present is currently experienced events, and its expected future is the causal/temporal implications of those past and present events for events that have yet to be experienced.

But the implied future isn't all that simple. First, the future isn't a single event, it is a sequence extending outward through time. Second, there always are multiple candidates for being the expected future. Both of these are because the present can imply more than one future to follow it, depending upon the reliability of the causal rules governing the implication. Moreover, each of these implied futures can imply more than one future to follow them, and each of those can imply more than one after that....and so forth, on into the distant future. The result can be thought of as a branching diagram that starts with what is happening now and fans out to the future. Each pathway along the branches is a scenario about the future, a potential sequence of future events that could follow from what is happening now. They're scenarios because they are alternative ways the future might unfold

(Beach, 2021).[1] They are potential because the pathways don't exist in a literal sense, they are merely sequences of logical implications—causal scaffolds for possible futures. All these potential futures would be too much to process during the rush of oncoming events, but it all works because most of them are so unlikely they are irrelevant. This whittles down the large number of potential futures to a small number, ending with a winner that becomes the expected future and a few runners-up that wouldn't be surprising if they happened instead.

Whether a pathway survives the whittling depends upon the reliability of the inferential (causal) links between its component events. As described in Essay #1, these links are seldom completely dependable; they may imply that A→B, but C, D, or E also are possible, even if B is more likely. This unreliability creates uncertainty about what each present event actually could end up causing in the immediate future and further uncertainty about what those events could cause in turn, and so on. If uncertainty were coded as a probability[2] for each causal link between events in a pathway, the probability that all of the events in any of the sequence of events will actually happen (and in that specific order) would be very small, and increasingly small the longer the sequence. This means that most of the potential futures are so unlikely that they are essentially impossible and therefore demand no attention.[3] (Even those few that aren't totally irrelevant aren't very likely, they simply are more likely than the rest. More to the point, these few are all that's left to work with after the impossible ones drop out. The most likely of them, however unlikely, is the winner and becomes the expected future. The others are the runners-up that wouldn't be too surprising if they happened instead.[4])

Two points: Even though the expected future isn't necessarily very likely, it really is the only glimpse of the future you've got. If you let the uncertainty deter you, you'd never do anything. Instead, you usually behave as though the expected future is considerably more likely than it is. You get away with this because you are flexible. When things don't turn out quite as you expect, you quickly adjust (see below) and keep on going. The end result is that rather than following a well-charted course into the future, you

[1] We use the term in the sense that scenario planners use it (e.g., Schoemaker, 1995).
[2] Bayesian, of course.
[3] Alternatively, your confidence in most of the potential futures ever happening is so low that you can ignore them.'
[4] Note that just because a path is so uncertain it is irrelevant to predicting the future does not mean that you can't think or talk about it. Fantasy, and sometimes genius, may lie in these seemingly impossible narratives. In fact, fantasy and genius are defined by their seeming impossibility.

actually feel your way along, adjusting course in light of incoming feedback (Beach & Wise, 1980).

The second point is that the further you try to look into the future, the less certain you are about what you see. Even if you could clearly picture the future, you would know it would be unlikely to turn out that way. You hope, pray, plan, scheme, and work hard to influence what happens, but your efforts can't extend very far forward; too much is out of your hands and even if you were in complete control, the rules you have aren't reliable enough to ensure success. Nonetheless, you survive and prosper, most of the time. Again, the reason is your flexibility—quickly adjusting to the unexpected—and persistence.

Action

Even though all this isn't encouraging, you can't give up and just let things happen. The point of having any interest in the future, after all, is less about being right than about being right about the right things—about being right about threats and their effective mitigation. So, just letting the future happen would miss the threats until it was too late, ending with discomfort at best and death at worst. Instead, you use what you have, the most probable of the improbable implied futures and its slightly less probable alternatives. If the most probable of them, the expected future, is unthreatening but one of the runners-up contains threats, action can attempt to block the latter while letting the former unfold as expected. More important, when the expected future is threatening, action can attempt to block it while letting an unthreatening runner-up occur instead. The advantage of the expected future and its runners-up all being drawn from the same implication thicket, is that no matter which of them happens, or at least which is closest to what happens, that future will be a fairly coherent extensions of the prime narrative's past and present. In TNT, and to the brain, coherence is everything because it is the measure of successful synthesis—a sign that the brain has done its job effectively.

Errors

When your expectations prove to be wrong, it means that your implication rules were wrong, that your prime narrative, upon which those expectations were based, is wrong, or that something in your habitat changed between the time your expectations formed and when the future materialized. Rule error means that the causal rules among past and present events that mispredicted the future were less reliable and deserved less

confidence than previously invested. This merely requires an adjustment. But errors in the prime narrative or changes in the habitat both require updating of the prime narrative.

As it turns out, recent perception research focuses on how your brain keeps up with changes in your habitat (e.g., Haque, Inati, Levy, & Zagloul, 2020; Summerfield, et al., 2006; Miller & White, 2021). This is called "predictive coding" or "predictive processing", the basic idea of which is that your perceptual system compares incoming sensations with expected (i.e., predicted) sensations and notes the discrepancies. The latter reveal the sizes and directions of habitat change, prompting changes in subsequent expectations. Applied repeatedly, this mechanism keeps your perceptual system abreast of changes in what is going on around you.

The simplest predictive coding/processing (PC/P) expectation would be that the habitat is static—that sensations will not change from one time to another. Discrepancies falsify the assumption—with the discrepancies specifying what is needed to bring expectations into line with experienced sensations. A less simple expectation would be that the world is dynamic but predictable; future stimulation will not be the same as past and present stimulation but it will follow current trends, etc.[5]

No doubt, you recognize the foregoing as a feedback loop, as described by control theory, which applies to a great many bodily/cognitive functions. What makes this application unique is that instead of the controlled variable changing to match the reference variable, it works the other way around. That is, instead of expectations being the given to which the habitat is adapted, as it would be when a thermostat turns on the heat to bring the room temperature up to some desired (expected) level, sensation/experience of the habitat is the given and the expectations, and whatever generated them, are changed to fit them.[6]

The PC/P hypothesis is relevant to our discussion because the mechanism is the same as the mechanism in TNT, albeit applied somewhat differently. That is, both PC/P and TNT require a knowledge base that sets expectations, a sensory system that is attuned to relevant variables in the habitat, a mechanism to compare the two, and the ability to use the discrepancies to revise the knowledge base so that it generates new expectations. They differ in their level of analysis, as well as in the focus of their research. PC/P describes at the sensory/perception level what TNT

[5] The cited research shows all this doesn't happen all in one place in the brain, it is distributed. It appears to be an "up from vision" development, using the same cortical columnar arrangements that visual cortex uses.

[6] This is called allostasis (Sterling & Eyer, 1988), as opposed to the more familiar homeostasis (Cannon, 1932).

describes for cognition in general. Moreover, PC/P research is focused on the parts of the brain that contribute to those processes. For TNT, it is sufficient to note that this evolving body of research exists and that it is supportive of the underlying TNT logic. [That is, TNT is in part built on the idea that mechanisms that evolved for lower level processes were adopted (and adapted) later on when higher level processes evolved—which is why feedback loops are so ubiquitous.]

In what follows, we will explore the TNT generalization of this expectation/discrepancy perceptual mechanism to higher-level expectations, especially when those expectations prove to be wrong.

PC/P assumes that the knowledge-base that gives rise to erroneous expectations is revised in light of discrepancies to better align with "reality". So, does TNT. PC/P doesn't specify why or how revision happens. But TNT does: Currently experienced events, expected or not, are *always* integrated into the prime narrative, forming the present, which almost instantly becomes the immediate past. If the expectations were right, what's happening now fits comfortably into the prime narrative and therefore requires no changes, so the prime narrative's coherence is unchanged. On the other hand, if the expectations were wrong, the unexpected current events don't fit comfortably into the prime narrative and their inclusion reduces its coherence, which makes the brain's synthesis processes kick in because reduced coherence signals that synthesis isn't complete—there is more work to be done. The brain begins by searching for events in the past that can account for what is happening now, for the reason why it happened instead of what was expected.

Much as we saw above for the implied future, the past consists of a thicket of implicatory pathways, but these run backward in time from the present. (Alternatively, they converge from the diffuse distant past to the specific present; same thing.) And each is a scenario about how you got here from there. Because past events actually happened, probability isn't really applicable. But we still can speak of the unreliability (uncertainty) of the links among those events. This allows us to apply the same logic we applied to pathways into the future—but maybe we ought to use some other word than probability (implication is a good one). Anyway, one of the pathways was what led to the previously mispredicted, expected future. When what actually happened is integrated into the prime narrative's immediate past, the pathway *that would have predicted it* becomes the new "true history", the putative reason why the unexpected happened, the backstory about how the past "accounts for" what actually happened instead of what was expected to happen. And, because this story restores coherence to the prime narrative, you often feel as if you knew it all along.

Afterword

This essay covers a lot of ground. First, it described how experience is synthesized from sensations and the prime narrative comes to be. Second, it described how expectations for the immediate and remote future come to be and how one set of expectations becomes the "official" expected future. Third, it described what happens when expectations aren't met, when something else happens instead. This requires reevaluation of the ways in which the past could have predicted what happened rather than the erroneous future it in fact predicted. Doing so identifies a new path through the past, a new backstory, which makes sense of what happened, that accounts for it. In the process it modifies the prime narrative's causal rules, decreasing confidence in the reliability of the ones that made the erroneous prediction and increasing confidence in the rules in the backstory story that accounts for what actually happened instead.

Overall, this is seen as parallel to theories being developed in neuropsychology that focus upon discrepant information to keep an information base up to date and increase prediction precision. We just happen to think that TNT does it a bit better.

Essay #6:
Threats

We frequently are asked why TNT focuses on threats rather than goals and opportunities. This essay is an attempt to answer that question.

Simply consider the facts: Numerous studies find that, as a general principle, people's disutility for a loss is greater than their utility for an equivalent gain. Or, consider that research has repeatedly shown that decisions about the acceptability of alternative futures are almost wholly determined by the unsatisfactory features of those alternatives (Beach & Strom, 1989). That is, choices are determined by the threat of having to live with those unsatisfactory features if a particular future were to happen. And it is not a trade-off, good features cannot balance out bad features. Other studies show that when presented with multiple options for the future, people screen out the ones that fall short (threats) of their standards and then use one of any number of strategies to pick from among the survivors based on the relative goodness of their features (Christensen-Szalanski, 1978, 1980). Moreover, it takes less negative evidence to decide that something is bad (threatening) than it does to decide something is good (Globig, Witte, et al, 2021). Which suggests that detecting bad things has greater priority than detecting good things. In short, the threat of bad things is far more significant than the allure of good things

Or consider common knowledge about weather forecasters, who know that it is better to mispredict bad weather than good; if they say it is going to be cloudy and the sun comes out, nobody will much care. But if they say the sun will shine and it doesn't, people will complain. Similarly, market analysts who predict a bear and get a bull aren't much condemned. And, a physician's incorrect diagnosis of cancer is more forgivable than an incorrect one that misses the cancer. Or business people, who are much more concerned about spotting potentially bad surprises and heading them off than they are about spotting good ones. (For what it's worth, we read someplace that the stories most read and most shared on Facebook are the most negative, as though knowing about something bad is forearmed.) Or, conspiracy theories, which are much in fashion these days, never are about cabals out to do good. Or parents, who are generally more distressed by their children's bad behavior than they are pleased by their good behavior.

Finally, it is commonly understood by origin-of-life researchers that life arouse out of the surrounding environmental matrix rather than plopping down into it. And even the simplest life-form exhibits characteristics that prevent it from being absorbed back into the environmental matrix. Which is to say, life had a trajectory from very early on: avoid anything that could result in reabsorption. This trajectory set the stage for threat avoidance being pre-eminent in the motivational hierarchy of living things. For animals, this requires avoidance of anything that can wound or kill, including anything that produces notable discomfort as a possible prelude to being hurt or killed. Some only react to adverse impingement on their senses after it happens, usually by withdrawing. But, "higher level" animals' reactions are more complicated. Humans in particular anticipate future threats and try to prevent or reduce them before they occur.

The ability to conceive of a dangerous future comes at the price of constant vigilance; even if things are good, they may soon turn bad. You never know what danger lies around the next corner or behind the next bush or boulder, or even the next social encounter. By definition, good things are unlikely to hurt you, so they don't require much attention; it's the bad things that require vigilance and readiness to take defensive action. No amount of successful avoidance or mitigation of threat can compensate for even one significant calamity.[1]

Aspirations, Goals, Rewards, and Opportunities

But surely not everything is about threats. Well, yes, it is. Recall from Essay #1 that enduring values and transitory preferences are the standards for what constitutes a desirable future. Which is to say, standards define aspirations, goals, and rewards. But standards are ideals and the expected future is real, or at least as real as any guess about the future can be. As a result, expectations seldom fully satisfy your standards. Decisions about what qualifies as a threat turn on the discrepancy between the various events that constitute the expected future and your applicable standards. You can

[1] Concern about the future and its threats is called "worrying", and in excess it is called Generalized Anxiety Disorder. It is a distortion of the normal emotional component of vigilance and anticipation of threats (LaFreniere, 2021). It is mostly a waste of time and energy; research suggests that less than 10% of what people worry about actually happens (e.g., LaFreniere & Newman, 2020) and when it does happen, the emotional pain is less than was feared and the ability to cope is greater than anticipated (Wilson & Gilbert, 2005). By and large, the emotional cost of excessive worrying is far greater than the assumed benefits of being forearmed against the real and imagined threats.

think of each standard as having an interval around it within which any expected event is regarded as essentially equivalent to it, i.e., "close enough" (Beach, Beach, Carter & Barclay, 1974; Crocker, Mitchell & Beach, 1978). If the event is outside this equivalence interval, which need not be symmetric, it is a threat—either too much or too little.

But every threat is also an opportunity for action to ensure that the future conforms more closely to your standards—to your aspirations, goals, and desires. Looked at this way, standards are what we strive for and threats are opportunities to fail or to take action to head off failure.

Some Consequences

Let us consider two prominent consequences of human sensitivity to threats. The first is on the individual level and the second is on the collective level. In both cases, the attempt to detect and mitigate threats is an attempt to *control* the future.

On the individual level, we suspect that the major motivator of behavior is to defend against threats by maintaining a comfortable level of control over what is going to happen. After all, loss of control risks being blind-sided. The emotional concomitants of reduced control, or even the potential loss of control, range from mild anxiety to debilitating terror. Of course, different people respond to a given level of risk with different degrees of mobilization and emotional intensity. Some are more able to deal with it, even finding some kinds of threat attractive (think bungie jumping); others find virtually all threats averse and ambitiously attempt to avoid them by maintaining control, even in situations in which control isn't productive or even possible.

Maintaining control is complicated by fact that threats cannot be dealt with directly. Because threats lie in the future, they are only inferences; they're not yet real events. As such, they can't be physically manipulated. The only way you can mitigate them is by acting upon the present, on real events and their implications. You do this by using your causal what-to-do rules (Essay #1) to modify the present and immediate future in attempt to change the flow of events so the threatening event(s) either doesn't happen or its damage is reduced. It is not unlike driving your car; you turn the steering wheel in anticipation of a turn in the road ahead, you step on the break in anticipation of traffic slowing for a red light. Both turning the wheel and slowing the car change the trajectory of your movement into both the spatial and temporal future. Presuming your actions were appropriate, you don't run off the road or rear-end the car in front of you, thus mitigating the anticipated threat.

Manipulation of the present to mitigate future threat occurs in two highly overlapping spheres. One is manipulation of the physical features of your habitat (turning the steering wheel or stepping on the break peddle) and the other is manipulation of the social/conceptual features (screaming at whomever is driving to turn or to step on the break). In the former, you manipulate actual physical objects in a way that prevents some threatening event from happening or at least changes it in some helpful way. Thus, in a non-automotive example, when your present experience (symptoms) implies the threat of a migraine, you can head it off or lessen it by taking a pill (an object) that has, in the past, prevented or diminished the pain. Note that the migraine is only an implication of the current symptoms at this point, an anticipated threat. But, the symptoms and pill are in the present and the what-to-do rule is *symptoms→pill→dimished or avoided pain*, where pain (or its absence) is in the future.

Returning to auto metaphors, if your gas gage tells you (present) that your car will run out of gas (a future threat), you can decide (present) to pull into the next gas station (immediate future) to fill the tank, which will mitigate the threat (intermediate future). In this case, the gage prompts you to go get gas to prevent running out, which is a plan that extends from the present into the immediate future with implications for the intermediate future. But, the example is all about objects—things—and moving them and yourself around in a physical world.

Mitigating threats in the social/conceptual part of your habitat works in much the same way, but it relies on words, gestures, and facial expressions rather than on manipulation of objects. By and large, social communication is aimed at reducing a perceived threat by changing the other person's behavior (in the extreme case, when you scream at the driver to turn or step on the brake). One of the most common ways of doing this is by threatening loss of your esteem if the other doesn't comply. The proposition is simple but it is more often merely understood by both parties rather than overtly stated, you don't actually say "Don't do X or you'll lose my esteem" or "Do X and you'll gain my esteem," but the other person knows the rules. Thus, for example, parents commonly discipline their children by withholding esteem (their approval, not necessarily their love). Doing this creates a threat of loss for the child and a rule for mitigating it: "If I misbehave, Mom won't like me very much, which would be an unpleasant loss. To avoid the loss and unpleasantness, I shouldn't misbehave." Of course, the child doesn't have to think this through; it is simply a rule learned in infancy.

Control usually is a good thing, but over-control isn't. Some people attempt to exert such complete control that their attempts create threats of their own. For example, the parent or spouse who seeks to control a sibling

or spouse so completely as to avoid any kind of threat—either to the other or to themselves—becomes more like a prison guard than a loving family member. Too, the person who tries too hard to control their own future may slip into illusory control; self-discipline being a common example. "If I can control my weight by restricting what I eat or by punishing exercise I will be loved." Or, "If I can live in pious poverty and self-denial, I will be rewarded in the afterlife." Or, "If I make sure everything in my house has a place and is always in its place, everything will be fine. If I can't, everything will fall apart." We've all met people whose only indulgence is their lack of indulgence.

Let's turn to the communal level: On January 6, 2021, a mob attacked the Capital Building in Washington, D.C. Those of us who were appalled are still asking how things came to this; what is it that led these people to do what they did? More to the present point, how does TNT account for what they did?

Commentators offer many reasons, prominent among which is a sense among the rioters that their government has failed them; that the needs of minorities have taken precedent over theirs; and that immigration is both out of control and creating unfair competition for employment, etc. The counterargument is that videos of the rioters showed predominantly middle-class people who at least had the funds to make the trip to Washington and purchase protective gear, elaborate flags and banners, and, in some cases, weapons. Nobody looked particularly downtrodden, neglected, or poor. So, what's their problem?

We think their problem reflects a universal phenomenon that has its roots in the primacy of threat. To start with, as people mature, virtually everyone comes to understand that the world can be a dangerous place. To one degree or other, each of us knows that something bad could happen without warning—that good things tend to be transient and are followed by bad things. Moreover, good things don't compensate for the bad things, which often leave indelible scars and irreparable wreckage in their wake. Even if the bad things aren't all that bad, they aren't good. Every moment of security is brittle and could easily fall apart.

But to feel generalized unease isn't the same as knowing what the threat actually is. Unspecified unease, the sense that things aren't going well but you don't quite know what or why, is called anxiety.[2] Because you can never be entirely certain about the future, there always is at least some anxiety; it

[2] Philosophers have called it "existential angst"; the weariness of extended vigilance, of keeping watch over oneself and those one values, of hoping things will get better but fearing they won't. It is the human condition.

is what keeps us vigilant to threats and it is the price we pay for being aware of the future and its potential for threats.

TNT tells us that humans are cause and effect creatures. We need to know causes in order to know where to direct action to produce desired effects particularly, and especially to fend off threats. This is fundamental to how we operate and we find ourselves constantly in pursuit of "Why?" Indeed, in an effort to boost the prime narrative's coherence as well as to reduce our anxiety, we go to great effort to discover causes when they aren't immediately apparent. Similarly, when anxiety increases, we look for the reason. If we are in clear danger (war, pandemic, etc.) the entirety of our anxiety can be attributed to it—it doesn't reduce it but it justifies it, makes the prime narrative coherent, and removes the need to look further for a cause. But, when no specific danger is apparent, our anxiety is difficult to account for, we feel threatened, but we don't know by what.

Unrelieved anxiety can produce a significant amount of pent-up energy; without a cause to target, the urge for mitigating action has nowhere to go. Individuals frequently try to solve this by "letting off steam"—parties, real or vicarious participation in sports, and so on. Sometimes immersion in a gripping movie or play will do the trick, or an argument, or a rant, or a good cry.[3] Groups solve it in much the same way, but being with others sometimes magnifies the energy. When it becomes big enough, it can be difficult to control, frequently ending in violence—the so-called madness of crowds or mob mentality. Every culture, past and present, has had to deal with this danger, often by (explicitly or implicitly) designating specific ideas or people as acceptable targets. In the U.S., segments of the culture have variously targeted government, Catholics, Muslims, Blacks, Jews, Asians, immigrants in general, Socialists, gays, etc., as the causes of their anxiety and, in some cases, have condoned otherwise unacceptable actions to mitigate it.[4] Designation of scapegoats is seldom official, but it usually

[3] There is ample evidence for both humans and other animals that aversive circumstances can induce aggression and violence (e.g., Lewon, Houmanfar & Haynes, 2019).

[4] In group theory terms, there is "closure under transformation" by hammering away on all of the real and imagined instances involving these types of groups' members. Then there is "centering"—establishing the Identity Transform— onto the Group closed structure. Then there is projection of the fear into the future –"translation operation"— convincing the disaffected of what will happen if they don't act. Then there is the use of "scale invariance", ramping up the perceived threats until it becomes nation threatening. Taking away all our freedoms! All of the invariant transforms of narrative are there to establish a strongly held belief waiting for one crystalizing suggestion—where and how to act on it. That crystallizing direction was

has champions who spur things on. For 100 years after the Civil War, the Ku Klux Klan was such a group, but these days there are so many groups it is difficult to keep track of them. And, they prompt growth of organizations to counter them, designating them as threats and sanctioning action against them. And so it goes—one big circle of violence and hatred all driven by a useless effort to turn off the anxiety that frequently isn't even related to its targets. All that it accomplishes is to add more threat and more anxiety; both for the targets and for those who target them and fear retaliation.

All of this is magnified by the fact that most cultures honor those who vanquish its enemies and there always are those who volunteer, basking in the rightness of their endeavor. So, the Proud Boys and others who attacked the U.S. Capital were answering the call to fight liberal government, the assumed cause of their anxiety. They saw themselves as heroes saving their corner of the culture and reducing its feeling of being under threat. But, after the excitement and exhilaration wore off, nothing they did actually addressed their underlying problems, because those problems can't be addressed, at least not directly. Since Eden, we've all paid for that first bite from the apple from the tree of knowledge; the future is coming and it is quite likely to be unpleasant.

Afterword

This essay describes why threats are such a key concept in TNT, how the theory deals with opportunities, and some of the consequences of the primacy of threats in real life. The essay on decision criteria and the discrepancy test (Essay #10) picks up the argument from here.

given by former President Trump in his address to the rally of his supporters. It didn't take any more thinking than that. In short, it is narrative thought gone wrong.

PART IV

RULES IN TNT

The three essays in this Part are a bit discursive. The first is about how psychologists have viewed causal rules over the years. The second is about how those older views inform our present conception of rules, especially how rules are acquired. The third is about rule reliability, or lack thereof, and its implications for subjective certainty about inferences based on rules.

ESSAY #7:
A SHORT HISTORY OF RULES IN PSYCHOLOGY

Changing the future requires action, but it has to be pertinent to expected threats and it has to have a reasonable chance of succeeding. This essay and the next are about how we make the right things happen. Here, we'll begin with the big picture, because psychology has long addressed the question of how creatures acquire the ability to make the right things happen. The next essay will examine how TNT, in particular, addresses the question.

Psychology's Darwin

We have heard it said that psychology is still waiting for its Darwin. That is, waiting for someone to provide the kind of pivotal concept that evolution provides for the (other) biological sciences.[1] But, we may have already had our Darwin, and his name was Edward Thorndike.

Thorndike (1874-1947) was a remarkable man.[2] After graduating in 1895 from Wesleyan University, with the highest-grade average in 50 years, he studied with William James at Harvard. While there, he did research on intelligence in chickens. It is difficult to imagine James being sympathetic to the topic, but he must have been; when Thorndike's landlady objected to baby chicks being kept in his room, he was allowed to move them to the basement of James' house. There he built a maze in which the chicks slowly learned to race to food, water, and the company of other chicks. Thorndike concluded that although the observed learning didn't reveal intelligence, it revealed something more basic; acts that lead to pleasure are repeated, and acts that don't, aren't.

Thorndike left James and Harvard to finish his Ph.D. at Columbia with James McKeen Cattell, who, like James, was a founder of modern psychology. This time he studied cats and how they learned to escape from a specially

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[1] Of course, evolution is central to psychology as a biological science but, in addition, we need something more specific to our level of discourse.

[2] The source for all of this is an excellent history by Morton Hunt (1994). Incidentally, Thorndike also authored a popular dictionary, now called the Thorndike-Barnhart dictionary.

contrived box. On the basis of his chicken and cat research, Thorndike formulated a theory of learning called "connectionism." It had two laws; the Law of Effect, which said that the effect of an action (either annoying or satisfying) in particular circumstances determines whether it will be repeated in the same or similar circumstances, and the Law of Exercise, which says that the more frequently the action occurs in the particular circumstances, the more strongly the circumstances and action are connected. Of the two, the Law of Effect was the more fundamental because it posits a connection and how that connection comes to be established; the Law of Exercise is just a technical detail about what determines the connection's strength.[3] We'll have more to say about connectionism and the laws of Effect and Exercise in the essay that follows this one, but here the focus is on their impact on the development of modern psychology.

Although the Law of Effect may have expressed a core truth, it did so in general terms. It did not define annoying or satisfying effects nor did it propose a precise mechanism by which associations are strengthened or weakened. Indeed, it did not even say what connections are. But, these issues subsequently were addressed in Thorndike's elaboration of his connectionist theory and in his research, as well as the research of a great number of experimental psychologists during the 50-year ascendancy of Behaviorism—from about 1913 until well into the 1960's—which was built on his theory. Behaviorism was a massive experiment in explaining all behavior without recourse to mind or anything that smacked of mind. The working hypothesis was that all behavior is built upon Thorndike's connections. The Law of Effect became stimulus-response (S-R) conditioned reflexes that, thanks to Pavlov, were assumed to resemble naturally occurring sensory-motor reflexes. Annoying and satisfying effects were examined as positive and negative reinforcers and the connection mechanisms were examined as classical and operant conditioning. Connections were characterized as neurological and were studied by ablating selected areas of rats' brains and, more recently, using MRI and similar techniques on other animals, including humans.

Although more parochial aspects of Behaviorism have been liberalized in light of later interpretations of connections, such as the requirement of awareness of contingencies (at least for humans, e.g., Dulany, 1968), connectionism remains a feature of numerous areas of neuropsychology and learning research (aversion learning, for example). But, Behaviorism, as a movement, has pretty much faded from the scene, in some sense a victim of

[3] Although Thorndike's statement of his law varied a bit from time to time, this is the kernel.

its own success. Behaviorism's fundamental "anti-mentalism" tenet forced three or four generations of researchers to reject mind as an explanatory concept and to speak and think of behavior in more rigorous terms. With time, as ideological fervor diminished, they were able to bring this rigor to bear on what had once been the domain of mind, thus giving rise to a new cognitive psychology that has since become part of the broader field of cognitive science.

From Connections to Rules

As Behaviorist fervor subsided, making room for the present-day cognitivist viewpoint, it became necessary to reconsider connectionist theories of learning. Empirically, there could be no question that some forms of learning were well-characterized as connectionist; that the Law of Effect accounted for the data. And, there was an abundance of data; the Behaviorists were prolific experimenters. The problem was that this data didn't have much to say to the emerging cognitivist viewpoint.

Albert Bandera, the most visible early proponent of the cognitivist viewpoint, used connectionist terminology to talk about cognitive events that had previously been off limits to Behaviorists. But, neither he nor others like him addressed how the Law of Effect squared with the new viewpoint. Acknowledging that the idea had its roots in the thinking of the time, we think that the first explicit reinterpretation of connections was made about 40 years ago in a little-noted introductory psychology textbook (Beach, 1973). In it, the stimulus-response connection was interpreted as a cognitive rule rather than a neurological reflex. That is, classical conditioning (Pavlov's "conditioned reflex") was reinterpreted as a rule about what to expect when a particular circumstance is encountered; a *What-to-expect Rule*. B. F. Skinner's operant conditioning was reinterpreted as a rule about what to do when a particular circumstance is encountered; a *What-to-do Rule*. The general form of these rules, and of the Law of Effect, is If-Then; *if* this occurs, *then* that will happen. In most cases, the link between the *if* and the *then* is causal or interpreted as causal. These rules, and the If-Then form, were elaborated upon in the first book on TNT (Beach, 2010).

Unfortunately, Thorndike and his Law of Effect got lost in the enthusiasm to move beyond Behaviorism. Nobody repudiated him, but few talked anymore about the old triumvirate of Thorndike, Pavlov, and Skinner. Instead, the focus was on the computer analogy that spurred the new cognitivism, and information processing became the primary metaphor for cognition. Even then, If-Then rules remained central, if only because they are at the core of computer programming and, thus, at the core of the

information processing metaphor. In the 2010 and 2016 books on TNT, we explained how all of this led to the next cognitive revolution, of which TNT may yet play a part—we'll see.

Afterword

The next essay will elaborate on this essay's theme by examining what the research prompted by Thorndike's Law of Effect tells us about how cognitive rules are acquired. But, before moving on, we propose a toast to Edward Thorndike, psychology's Darwin.

ESSAY #8:
THE RULES OF RULE ACQUISITION

Thorndike's connectionism guided decades of research. True, from todays' viewpoint, most of it rather missed the point. But it kept lots of psychologists employed and, in the long run, provided a solid empirical foundation for something very basic—the rules of rule acquisition.

"Missing the point" was a side-effect of Behaviorism's wholehearted adoption of the Positivist view that psychology was solely about observable behavior; emotions, imagination, and thoughts were merely responses to specific stimuli like any other behavior. The basic units of analysis were simple input-output (stimulus-response, S-R) connections. Collectively called *reflexes*, these S-R connections included innate behaviors such as startle responses to loud sounds (which was the original meaning of "reflex") as well as S-R connections acquired through experience and strengthened by outcomes (called "reinforcements"). Complex behavior was the result of sequentially linked reflexes.

We doubt that the founders of the Behaviorism wholly believed this S-R reductionist view or were inflexibly doctrinaire about it. We suspect that for them it was all an experiment, an attempt to see how much mileage could be gained from reducing everything to S-R, "conditioned" reflexes.[1] Their followers, however, often became zealots, and something akin to a cult of aggressive Behaviorism dominated psychology, at least in the English-speaking world.

As with most movements, Behaviorism's shine eventually wore off. As psychologists' interests expanded beyond basic perception and learning, the ponderous S-R explanations required to account for complex behavior simply collapsed under their own weight. And, in the 1960's, almost as quickly as it rose to dominance, Behaviorism began to fade (aided by the loosening grip of Positivism on science in general). This isn't to say that the immense body of data that Behaviorists left behind disappeared or that what

[1] According to psychological lore, the term "conditioned" derives from a mistranslation from the Russian; Pavlov meant "conditional" but it was translated as conditioned. He wanted to say that the bond between the S and the R was conditional upon the reward. So, we got stuck with the awkward and obscure "conditioned reflex", both parts of which are misleading.

was learned was rejected or forgotten. When everyone moved on, they carried that knowledge forward but were less slavish in how they talked about it. The word "reflex" faded away, along with the reductionist and mechanistic view of behavior, and cognitive research took center stage. Now, it was acceptable to talk of mental states influencing behavior and to conduct research on thinking, judgment, decision making, on the nature of language and language acquisition, and all the rest. But, the lingering influence of Behaviorism was clear in the avoidance of anything suggesting a mystical mind—even the word "mind" was avoided. In this sense, Behaviorism left its imprint, inclining "scientific" psychology toward empiricism and objectivity and away from "squishy" things, like introspectionism or psychoanalytic psychology. Subsequently, cognitive research split from the rest of psychology, divorced itself from the American Psychological Association, and eventually merged with linguistics, neurology, and similar disciplines to form the new discipline of Cognitive Science.

Psychology is unique in that it is the only science in which the researcher also is the researched; the human mind studying the human mind. So, in its early days, it had no other science to which to turn for instruction about how to do research; nowhere from which to borrow a paradigm. Indeed, Behaviorism was an attempt to fill this void. So, when Behaviorism began to fade, psychologists need something to take its place. Fortunately, the work of developmental and perceptual researchers suggested a way forward. This took the form of a new metaphor; humans were no longer S→R automata, they were something very like the researchers themselves. People, and other creatures, now were viewed as intuitive scientists who learned about their environments through their senses, constructed a useful theory of it, and behaved in light of their theory.

The intuitive scientist metaphor turned out to be quite valuable, particularly in thinking about how people traverse and manipulate their physical worlds and how they deal with uncertainty. With time, the informational component of this metaphor became the central issue; the brain as a computer-like information processing device. Eventually, this became the new metaphor as experimental psychology morphed into cognitive science.

In all of this, Thorndike, the Behaviorists, and S-R psychology became somewhat lost. They were seen as an early, but now closed, chapter in the history of cognitive science. But, as we said in the previous essay, this is perhaps a bit too dismissive. They may have been on to something fundamentally important, something that got overlooked in the whole "reflex" and Behaviorism-as-a-cult adventure. That something is rules, rule

acquisition, and rule use as basic to human behavior. Not reflexes, but rules. And these rules cover a range from the simple to the complex, from reflexive muscle twitches to thinking about the universe.

Rules

In what follows, we will start with the common S→R terms (which will be in italics) and "translate" them into the language of TNT's rules.

Kinds of Conditioned Reflexes (i.e., Kinds of Rules)

The two kinds of conditioned reflexes are operant, for which Skinner's lever-pressing rat is the prototype, and classical, for which Pavlov's salivating dog is the prototype.

TNT Translation: There are two kinds of rules, *what-to-do* and *what-to-expect*, roughly corresponding to operant and classical conditioning respectively. Further, there are two kinds of what-to-do rules, the first of which is of the form "In this situation, do such-and-such"; written $S_1 \rightarrow A_1$, where the S_1 stands for a specific situation and the A_1 is the prescribed action, the such-and-such that is to be done.[2] This rule merely tells you what to do with no reference to the results of your action. This is the prototypical physiological reflex; someone yawns and you yawn, you touch a hot surface and you pull your hand away, or a nearby car honks and you flinch.

The second kind of rule is of the form, "In this situation, do such-and-such and then so-and-so is likely to happen"; written, $S_1 \rightarrow A_1 \rightarrow S_2$, where S_1 is the specific situation, A_1 is what is to be done in this situation to produce S_2, which is the so-and-so that is likely to happen—a statement about the *future*. This is the rule Skinner's thirsty rat was learning in the eponymous Skinner Box. Thirst and the box with its lever constitute S_1, pressing the lever constitutes A_1, and the few drops of water that then appears below the lever constitutes S_2. Unlike the first kind of what-to-do rule, this second kind includes the expected results of executing the correct behavior and, in so doing, constitutes a *prediction* of those results.

There is just one kind of what-to-expect rule (aka classically conditioned reflex); "If this occurs, that follows"; written, $S_1 \rightarrow S_2$, where S_1 is the situation and S_2 is the future situation. That is, the rule does not require any action. So, for example, Pavlov's dog learned that when a bell rang, food

[2] In previous essays and books on TNT, S has been used for situation and R for action when discussing rules. But, starting now, we replace by R with A for action to emphasize the difference from S-R psychology's $S_1 \rightarrow R_1$ reflex responses.

would follow. Consumption of food requires dogs' mouths to be moist, so they typically begin to salivate before eating (which is a $S_1 \rightarrow A_1$ rule, a physiological reflect). Pavlov found that, after a few pairings of the bell and food, the bell itself (S_1) elicited salivation in anticipation of the food (S_2). In effect, the bell told the dog to expect food and to be prepared for it by salivating, but the occurrence of the food was not conditional on salivation. That is, a $S_1 \rightarrow S_2$ rule constitutes a *prediction* of events predicated upon past and current events.

So, the upshot is that both the second kind of what-to-do rule ($S_1 \rightarrow A_1 \rightarrow S_2$) and the only kind of what-to-expect rule ($S_1 \rightarrow S_2$) constitute predictions about the future, one conditional upon you doing something and one just because that's usually what happens.

Conditions that Promote Conditioning (i.e., Conditions that Promote Rule Acquisition)

1. *Motivation*. The point of an $S_1 \rightarrow A_1 \rightarrow S_2$ rule is to do A_1 to produce S_2. This implies that you must value S_2 to some degree, and the more you value it, the more prone you are to learning the rule for obtaining it. This means that motivation has two aspects: First, it prompts you to learn the rule and, second, it prompts you to use the rule when the conditions (S_1) are right.

2. *Transfer*. When in a situation that is similar too, but not exactly the same as one for which you have a rule, the old rule may be a good beginning point for a new rule for the new situation. Of course, the old rule may even be sufficient, called *positive transfer*. But, sometimes similarly appearing situations actually aren't similar, or the differences are somehow crucial, so the old rule does not work or even may interfere with learning a workable rule, called *negative transfer*.

3. *Shaping*. When an old rule does not work well in a new situation, it is modified in terms of how closely its results approximate the valued results. Iterative changes in the old rule transforms it into a new rule that is suitable to the new situation.

4. *Reinforcement*. For either an $S_1 \rightarrow A_1 \rightarrow S_2$ rule or an $S_1 \rightarrow S_2$ to be established or modified, the results (S_2) must occur quickly enough to make it clear that the behavior (A_1) or prior event (S_1) caused it, rather than some unnoted influence. Timing is particularly important for $S_1 \rightarrow S_2$ rules. Think, for example, of trying to discover what food might have caused an allergic reaction—unless the reaction occurs pretty quickly after eating the food, or the food is particularly distinctive, it is difficult to discover what caused trouble.

Conditions that Promote Generalization, Discrimination, and Extinction (i.e., Conditions that Promote Rule Applicability or Abandonment)

1. *Generalization and Discrimination*. The application of rules is not a rigid thing. For example, each time you use an $S_1 \rightarrow A_1 \rightarrow S_2$ rule, the S_1 is not exactly the same as in the past, there usually are alternative ways to do A_1, and S_2 seldom is precisely the same as it was last time. So, if you are thirsty, S_1, it may be from exercise, or because you haven't drunk enough water that day, etc. And, you can deal with it (A_1) by drinking water, soda, coffee, etc. or, maybe, even sucking on a lemon. And the quenched thirst (S_2) can be complete or partial, satisfying or not. This allowable variability is called *stimulus* and *response generalization* by the S-R psychologists and simple (rule) adaptability by the rest of us.

By the same token, if there are meaningful differences between the current situation (S_1) and previous situations in which the rule worked, it is necessary to learn to discriminate between them and adapt accordingly. Learning the difference is called *stimulus discrimination* by S-R psychologists and adapting behavior to fit the situation is called *response discrimination*. It is merely called learning rule applicability by the rest of us.

2, *Extinction*. Sometimes a what-to-do rule fails to work because things have changed so the action no longer produces the valued result. This can be because the change is permanent (somebody changed the lock on your office door, so using you key won't work anymore) or because it is temporarily suspended (road repairs necessitate taking a different route to work for a while). Frequently, the response to a rule not working is to try again, and maybe even again. When it becomes clear that something has changed, you give up the rule and look for another way forward or forget about obtaining the valued result altogether. Temporary suspension of the rule, like the traffic diversion, prompts temporary suspension of the rule, but you'll probably try every now and then to see if the rule is working again. And, if the R_2 is only available now and then, either unexpectedly or at fixed intervals, you'll adopt a strategy to suit. True, chaotic occurrence may eventually lead to abandonment of the rule, but frequently the occasional triumph of being right may keep it in place long after it has ceased to be useful—that is what keeps gamblers going. And even an abandoned rule may pop up again from time to time just to see if it has regained its validity.

Origins of Rules

Table 8-1 shows the continuum of ways in which rules are acquired. The ways are above the line and the rules acquired by means of each way are listed below the line.

Table 8-1. Ways in which rules are acquired.

Reflexes	Instincts	Predispositions	Experience	Imitation	Reason
$S_1 \rightarrow A_1$	$S_1 \rightarrow A_1$	? ? ?	$S_1 \rightarrow A_1 \rightarrow S_2$	$S_1 \rightarrow A_1 \rightarrow S_2$	$S_1 \rightarrow A_1 \rightarrow S_2$
			$S_1 \rightarrow S_2$	$S_1 \rightarrow S_2$	$S_1 \rightarrow S_2$

Reflexes are exactly what you know them to be, innate automatic physiological responses to specific Instances or classes of events—like Pavlov's dog's salivation in preparation for eating. Every animal has such reflexive rules; indeed, some have only reflexive rules. Usually the lower on the phylogenetic scale the animal is, the more of its behavior is the result of $S_1 \rightarrow A_1$, what-to-do reflex rules.[3]

Instincts are a step beyond; more complex and the rule's application is less blindly automatic. Mating and migration rituals are good examples; they're formulaic and rule-bound, but are adaptable to circumstances.

Predispositions are still less reliant on circumstances, but as they include things like humans' predisposition to be suspicious or hostile toward outsiders, they are a step above instincts in that they often can be unlearned or at least kept under control when the context requires.

Experience is the origin about which the most is known, thanks to the S-R psychologists' research. All of their "conditioning" experiments were investigations of the acquisition of experience-based rules.

That research was expanded upon by neo-S-R experimenters who studied the conditions contributing to learning by imitation. So, we know that many creatures can learn by watching what some kindred creature does (presumably through the action of cortically located "mirror neurons"). In addition, humans can learn from verbal instruction (although in both cases, learning is surer if the learner actually practices the skill after watching or being instructed).

[3] When these rules are chained together, some incredibly complex looking behaviors may result. The sequence of a Tarantula Hawk wasp hunting, stinging, and laying eggs on Tarantulas, for example.

And, finally, the least understood and least researched origin, reasoned rules. The paucity of understanding is the result, possibly, of the problem of the mind studying the mind; it has been difficult to get a clear grip on this kind of learning. Just look at how we appraise (or, rather, don't) reasoned learning in the classroom, by examinations that focus on recall or application of specific sets of procedural rules, like algebra or geometry. Seldom is the focus on reasoned use of broader knowledge in various contexts. It is very difficult to study people's ability to reason without reference to some kind of artificial system, such as logic or statistical inference—both of which, ironically, are tools devised in the first place to help us do intellectual tasks at which we know we aren't particularly adept. The real feat of reasoning with such tools is with the folks who devised them, not college students trying to use them. Anyway, less is known about the formulation of reasoned rules than one might wish.

Afterword

This discussion will continue in the next essay because, once acquired, rules aren't always dependable, which has important implications for TNT.

ESSAY #9:
RULES AND CERTAINTY

Recall from Essay #1 that the reliability of a rule rests upon its determinacy, (including its track record), appropriateness, and source credibility. Jointly, they govern the degree to which you feel certain (or uncertain) that the rule's effect will occur as expected.[1] Confidence, sureness, belief, conviction are all synonyms for certainty, the subjective, *emotional*, measure of how much you trust that a rule's implied future actually will happen. Your overall certainty about the future is a combination of your certainty about each of the rules contributing to it (although it might not be decomposable into the distinct contributions of those different rules).

Certainty and Probability

Both muchness (of trust) and combination (across rules) suggest that certainty is quantifiable, which in turn suggests it has an underlying mathematically describable orderliness. This is a familiar concept in cognitive psychology, particularly in decision research. The general idea is that the less certain one feels about expected gains, the less willing one should be to risk resources on them; i.e., the less one should bet on them. And, through some rather straightforward logic, it is possible to measure certainty (as a probability) from willingness to accept specially constructed bets (Edwards, 1962; Beach & Phillips, 1967). Of course, this requires the assumption that certainty is, in fact, equivalent to probability in the first place. That is, it requires that certainty be what Laplace (1814) was referring to when he said, "The theory of probabilities is at bottom nothing but common sense reduced to calculus; it enables us to appreciate with exactness that which accurate minds feel with a sort of instinct for which ofttimes they are unable to account**."**

The equivalence of certainty and probability is fundamental to classical decision theory as it has been used in economics, management, decision

[1] We don't know how directness and dependability combine. Surely, they are not independent and the combinatorial rule probably is situational.

analysis, decision conferencing, and other applications. But, its truth has been put in doubt, primarily by researchers who championed a radically different view, the "heuristics and biases" (HB) view (Kahneman & Tversky, 1974). In what we have come to think of as The Great Probability War, the proponents of the HB view claimed their data proved that the required order underlying certainty does not exist, at least not in the form described by probability theory. The defenders of the opposing view, that certainty is probability-like (P-L), claimed their data demonstrated that order exists and in roughly the form, described by probability theory (reviewed by Peterson & Beach, 1967). That is, the P-L claim was that certainty is probability-like but it does not necessarily conform to all of the logical requirements of probability theory. The P-L folks reasoned that probability and probability theory are formal and more rigorous extensions of the intuitive logic of certainty. As such, probability and probability theory are tools, like hammers and saws and any tool that extends our ability to do a task—in this case, dealing with certainty/uncertainty at levels beyond our private intuitions.

The HB movement (and it was more like a flood) was aimed at demonstrating that probability theory cannot be regarded as the calculus of certainty; that no theory of choice can justifiably represent certainty in terms of probability. This was a profound statement because it robs us of the opportunity to better understand uncertainty as an orderly, structured process. And it had profound effects, in both the discipline of economics (winning a major HB proponent, Daniel Kahneman, a Nobel Prize) and the psychology of decision making. Even more, the HB claims were broadly interpreted as an indictment of human reasoning in general.

In its most benign form the HB indictment simply stated that humans use heuristics to make judgments about probabilities; simple rules of thumb to make the task easier. To the degree that the heuristics differ from how a statistician would arrive at the probabilities, the resulting judgements also differ, called bias. In its least benign form, the HB indictment states that human reasoning is seriously flawed, that humans are irrational, intellectual cripples. (Of course, this statement assumes that probability theory equates with all of human rationality, a big assumption.)

In a remarkably short time, the HB view soundly trounced the P-L view, definitively winning The Great Probability War. Using materials adapted from those used by Kahneman and Tversky in their demonstrations, the search for biases became the order of the day.[2] Interestingly, none of the obtained data actually proved the P-L data to be wrong; in currently popular

[2] Wikipedia lists well over 100 different biases, in a variety of different areas.

jargon, they simply "canceled" them. It was as though the P-L data simply ceased to exist.

A few years after the HB victory, Beach and Braun (1994) advanced a hypothesis for why research performed by the two sides in the war might have led to such starkly different conclusions. Speaking of those early years when studies of biases were being churned out at a remarkable rate, we said of the P-L's very different research results: "[In] study after study [P-L researchers] obtained results that were at variance with everything else in the then-growing [HB] literature. But, in retrospect, [the P-L] studies can be seen to have one feature that makes them different from the ... [HB] studies, a feature that was quite overlooked at the time." This feature was experience.

Most HB studies presented participants with written paragraphs describing various situations to which statistics could be applied. Then, without bringing the participant's attention to the statistical features of the situations, judgments were obtained and compared to the "correct" answers provided by the appropriate part of statistical theory. The consistent finding was that the judgments differed greatly, but in a fairly orderly manner, from the "correct" answers.

In contrast, in most P-L studies, participants were given experience with the events before they were asked to assess probabilities (e.g., flashing lights, cards in decks, samples from urns, pictures, and familiar real-life events). And the consistent finding was that judgments complied with the requirements of probability theory—not exactly, but far too closely to be either irrelevant or an accident.

Beach and Braun never followed through on their observation about experience, but recently Tomas Lejarraga and Ralph Hertwig, (2021) did. It's unlikely they ever read the Beach & Braun (1994) article; it is long out of print. But, even though they came to the issue by a different route, the important thing is that their methods were inventive and their results are clear. They compared 158 experiments in studies cited in the Peterson and Beach's (1967) review, which defined the P-L view, with 30 experiments in studies cited in the Kahneman & Tversky (1974) article, which defined the HB alternative view. The comparison revealed that, whatever might be true about underlying order, the research data supporting the two different views were more attributable to how the experiments were done than to which view was right. In short, the Lejarraga & Hertwig, (2021) results take us right back to 1974, when the War began. They require the marketplace of ideas to reconsider the issue, and to demand more sophistication on both sides if the issue is to be resolved.

Even if there were no "experience" issues, the data from both views' research are difficult to interpret. First, because both sets of data come from

artificial tasks—e.g., flashing lights and specially designed story problems—neither of which are the sorts of things about which people normally feel especially certain or uncertain. Second, and more to the point, neither set of data is really about certainty, they are about chance.

Certainty is not about chance, at least not per se. It is about the reliability of *causal rules*. Experiments that make it solely about randomness and relative frequencies don't have much to say about its nature because they overlook the essence of the issue, which is causality. Probability theory and statistics emphasize randomness and chance, explicitly excluding causality, but certainty is explicitly about causality.

We think the foregoing has much in common with the problem discussed by Greenland (2020) about the application of probability and statistics in experimental research. "...(S)tatistical analyses need a causal skeleton to connect to the world, causality is not extra-statistical but instead is a logical antecedent of real-world inferences" (p. 2). "Probability is inadequate as a foundation for applied statistics, because competent statistical practice integrates logic, context, and probability into scientific inference and decision, using narratives built around causality" (p. 2). "...(R)ealistic statistical analysis is a subset of causal analysis" (p.8).

Perhaps the last paragraph is overreach on our part, but it appears the common issue is lack of a causal foundation, both in experiments about subjective probabilities and in applied statistics in general. Causality is, after all, the foundation of knowledge about one's habitat and how it works; certainty, probability (and statistical analyses) don't exist without it. So, to purposely exclude it seems peculiar; a triumph of mathematical purity over insight and reason. We submit that all of this applies equally, or more so, to studies of certainty in the context of probabilities and probability theory.[3]

Before moving on, we need to say a little about Bayesian probabilities and Bayesian "causal probability theory". We'll assume you know what Bayesian probabilities are, but what's important here is what they aren't. They aren't fundamentally different from ordinary probabilities in terms of the math; so all the calculations are much the same. The big difference is that judged probabilities, subjective probabilities, confidence, degrees of belief, etc. are admissible. That is, instead of being defined solely in terms of frequency or necessity, Bayesian probabilities can be subjective probabilities (as long as they meet specific requirements). Indeed, the initial

[3] Probability without causality may be problematic, but so is causality without probability. That is, if certainty is about the reliability of causality, and certainty can be cast as probability, then probability is part of subject appraisals of causality, perhaps even a property of causality (Suppes, 1970).

interest in Bayesian theory, and the motivation for its development, is that it describes how *opinion* can be updated in light of pertinent information.

For some of the same reasons outlined by Greenland, above, there has been an interest in merging Bayesian probability theory with causal logic, yielding probabilities derived from causal reasoning (Pearl, 2000; Peterson, 1973; Phillips, 2005). The two are not unrelated, of course, but it strikes us that, in both cases, the structures and mathematics become quite complex for even rather simple situations; that's why analysists use matrices, hierarchies and other useful pictures. As a result, we have difficulty thinking that they characterize the unaided subjective appraisals of certainty discussed in TNT. It seems to us that something more straightforward is required—something simpler. At first we thought that we might hold this opinion because our math is rusty and we have difficulty following the arguments. But, now we think it is more than that. We were trying to understand things from the point of view of psychologists hoping to find a causal probability theory that would provide a calculus for narrative-based causal certainty. But, neither standard nor Bayesian probability were developed for that. They were developed for formal decision analytic applications and for use in artificial intelligence, not for natural thinking. And, even though they address some of the same issues, we don't think that, in their present form, they are what is needed for the rough and ready appraisals of certainty that are part of ongoing everyday life. But, and it is a big "but", Bayesian probability may provide a good model for thinking about a more specific description of the calculus of certainty.

The Next Phase

Returning to The Great Probability War, the HB victory sort of brought things to a halt for the P-L folks. But not for long. The P-L folks simply said that if decision makers' certainty doesn't conform to probability theory, it should. This turned their interest toward decision aiding systems; ways of helping people make decisions the way they "should" make them. Primary among these systems was decision analysis, the strategy of which is to divide a decision problem into its component parts and have informed judges make probability and utility judgments for each of those parts. Then the judgments are combined by a computer according to the mathematical operations of probability theory (including Bayesian probability), utility theory, and decision theory—i.e., as they "should" be combined. Which is to say, decision makers provide the input, the computer computes, and the output is a prescribed decision that follows from the input if the decision

maker were "doing it right". Of course, this is an oversimplification, but it's the general idea.

Decision analysis, and its use in decision conferencing and decision support, has become something of an industry. And, its success encouraged researchers to use its general logic as a research tool. That is, their working assumption was that people's private, everyday decisions were naturally made as they "should" be made and by running the models backwards, so to speak, it would be possible to discover the major contributors to those decisions. For example, some of us investigated the factors contributing to couples' decisions about having a (or another) baby. Then we moved on to decisions about commuting by bus or by car (for Seattle's transit company), about getting a flu shot or not (for the VA), about participating in sports (for college kids), about whether to have surgery (for a medical clinic), whether to give up smoking (for a smoking prevention program), and so on.

Even though our clients were satisfied with our analyses, it really wasn't working the way it should. Early on, during the birth planning research, there was a distressing discovery; we could account for people's decisions solely by what was important to them—probabilities didn't do a thing. In fact, this was so apparent in this and our other research, that we stopped asking for probability judgments.

At first this finding was baffling; it went against everything apparently settled about decision making. Like all P-L decision researchers, we all "knew" that uncertainty/probability is a major part of decision making. After all, it is the way that the utility of future payoffs is discounted in light of their unlikeliness; i.e., how people temper desire with risk. It was at the heart of the gamble metaphor underlying decision theory. After a suitable amount of floundering and brooding, it occurred to us that the problem wasn't so much conceptual as it was practical. We weren't looking at everything involved in real-life, personal decisions. In fact, we weren't looking at things very realistically at all. Real-life personal decisions aren't gambles, if only because people know that after they make them, they haven't settled anything—they still have to work to make things come out right. That is, decision theory relies on the metaphor of a gambler who has to place a bet and then sit and wait for the outcome; intervention isn't allowed in gambling, that's cheating. In contrast, in real life, intervention is everything—only a fool would fail to do it. We seldom sit back and wait to see what happens—by then it is too late. Instead, we decide what we want (or don't want) and set out to get it (or prevent it). We control outcomes by how much effort and thought we invest in making them happen (or not happen). And, if our efforts look like they will fail, we change course, try something else.

The insight here is that certainty isn't so much about the decision *per se*, it is more about what happens afterward. And the corollary of this insight is that decision theory, which clearly has its uses, isn't a good psychological model of decision making (Beach & Lipschitz, 1993). What is needed instead is a way of characterizing decisions within the context of the ongoing drama and trauma that is the saga of our individual lives. This means that we have to recast utility in terms of the enduring values and transient preferences, our standards, which shape our lives. We have to recast certainty, not so much as a probability, but as a motivator and moderator of the action that springs from our narratives.[4] This was the beginning of TNT.[5]

Certainty in TNT

Regardless of whether certainty can be treated as a probability, it derives from the people's feelings about the reliability of their causal rules. Reliability, as we said above, derives from apparent rule determinacy, track record, appropriateness, and source credibility. Certainty goes beyond probability to consider contextual considerations, things that are going on that might make the rule's inferences less, or more, trustworthy than they otherwise might be. Of course, context is in the form of other rules, about the effects of various external factors on the rules of interest, so it all boils down to rules and confidence about the future they imply.

1. Certainty about the implications of a rule for the future is dictated by the rule's reliability.

2. The prime narrative's predicted future is not restricted to the implications of a single rule; multiple rules are involved, each providing a prediction of some aspect (event) of the future. Of course, there is a main trust, the strongest chain of linked causes (events) and effects (events) from the past, through the present, and into the future. But, there are also less prominent, weaker, chains that fill in the details, perhaps about the venue in which the main events will unfold or the participants and objects that will participate in the main events, and so on. As a result, overall certainty about the future is a synthesis (what the brain does so very well) of the certainty associated with each of the rules contributing to that future.[6]

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[4] See Szollosi & Newell (2020) for a more on this topic.

[5] Actually, it was the beginning of Image Theory (Beach & Mitchell, 1987, 1990), which eventually became TNT.

[6] See Meder, Mayrhofer, & Waldman (2014) for more on this topic.

3. The future events implied by a rule will have implications, and those implications will have implications, and so on into the remote future. As described in Essays #5 and #10, confidence in the validity of this long-view prediction of the future decreases as the chain of implications gets longer. The chain ends (the time horizon) when confidence falls below some minimally acceptable level—the point at which confidence becomes lack of confidence.

4. Since each event in the predicted future is the causal implication of a rule, certainty about a threatening event is the same as certainty about the rule that implied it.

5. Certainty about a threat contributes to motivation for action to mitigate the threat. Motivation is a combination of the degree of threat and degree of certainty that the threatening event will happen. Note that motivation to mitigate is not compensatory; if a threat is significant and if certainty about it occurring is significant, action must be taken no matter how unthreatening the rest of the predicted future may be.

6. The overall threat of the future is the combined significance of the various threats in that future and the combined confidence that those threats will materialize if action is not taken to mitigate them.

7. Potential mitigating actions are sets of rules, recipes, for preventing or lessening future threats (Beach, 2010). Collectively, the rules in the set imply the future that will result from implementing the action. And, like any rules, they evoke a degree of certainty about their implied future. The set of mitigating rules, the plans of action, for which the implied (presumably threat-free) future is most certain is the best choice for implementation to mitigate threat in the prime narrative's predicted future.

8. A coherent narrative narrows the range of implied future events, thus narrowing the range of conceivable threats, thus narrowing the focus of mitigating action. So, increased coherence equals increased certainty that the predicted future is what will happen and that any threats in that future will be detected and mitigated.

Afterword

The work of Lejarraga and Hertwig, (2021) may or may not reopen the Great Probability War, but whatever happens, it doesn't change the basic problem or entirely make clear how to address it experimentally. That problem is how to characterize uncertainty within the framework of the causal logic that is how people normally think about the future and that is foundational to the organization of the experience and knowledge. We think TNT helps clarify the issues, which we've tried to outline in this essay, but

we'll have to see what happens. The marketplace of ideas is fickle and biased toward simplistic, gimmicky ideas to the exclusion of ideas that are more complex but make more sense.

This essay sets the stage for the first essay in the next part of the book, in which the focus is on what happens after the rules in the prime narrative predict (imply) the future, prompting decisions about threats and, if required, triggering mitigating action. Specifically, how TNT's discrepancy test differs from other theories of decision making.

PART V

DECISIONS IN TNT

The two essays that follow are a continuation of the previous three. The first of the two contrasts TNT's version of what determines decisions with traditional decision theories. The second of the two describes tools, called decision aids, for helping with difficult, narrative-based, decisions.

Essay #10:
Decision Criteria

Perhaps the most prominent feature of any attempt to describe decision making is the criterion that is presumed to determine whether you will continue on your present course or change direction. In what follows, we will describe four theories of decision making and their respective decision criteria.

The Law of Effect's Criterion: Situational Similarity

We will be brief about the Law of Effect because we've already seen how, in the late 1800's, Edward Thorndike "discovered" it in the context of laboratory studies of chickens and cats and ended up shaping 50 years of S→R research on rule acquisition. As a decision criterion, The Law of Effect's situational similarity criterion states that a learned rules will be (automatically/reflexively) exercised in situations that are sufficiently similar to the situations in which they were acquired.

Economic Man's Criterion: Maximization of Payoff

Maximization as a decision criterion has its roots in moral philosophy, particularly Utilitarianism (Mill, 1863), which began as instructions to public decision makers about how to make moral and ethical choices (Gay, 1731). The thesis was that the greatest happiness of the greatest number of citizens is the measure of right and wrong. The mechanism for achieving this is illustrated by Bentham's (1789) Felicific Calculus, which prescribes summing the values of all the pleasures that will result from performing an act and summing the values of all the pains that will result. The amount by which the balance between the two sums favors pleasure is "the good tendency of the act upon the whole," and the amount by which it favors pain is "the bad tendency of it upon the whole."

Even before Bentham, Utilitarian concepts had been applied to private and business decisions (Bernoulli, 1738), which encouraged their refinement and elaboration, culminating in modern Utility Theory (von Neumann & Morgenstern, 1944; Luce & Raiffa, 1957). Utility Theory purports to

measure the psychological worth (utility) to an individual decision maker of the anticipated outcomes of his or her potential actions.[1] Because outcomes are in the future and may or may not materialize, the degree of doubt about them actually accruing to the decision maker is represented by probabilities that discount what they would be worth (their utility) if there were no doubt. The discounted utilities are called expected utilities. Using expected utilities in a mathematically sophisticated version of Bentham's Felicific Calculus provides a way to evaluate the potential of each available course of action (the balance between the sum of the discounted good utilities and the sum of the discounted bad utilities for each course of action) and a decision rule (select the course of action that has the largest positive balance between good and bad discounted utilities). This is called maximization of expected utility.

Economics is the discipline that endeavors to explain decision making in the marketplace. To do this, economists build theories in which economic decision makers are seen as trying to maximize their prosperity. This requires a mechanism for choice among competing courses of action, each of which offers gains and losses. As we have seen, utility theory purports to provide both a way of measuring potential gains and losses, expected utility, and a mechanism for choice—maximization of expected utility. Both concepts became integral to economic theory.

Economists are not psychologists, so few ever asked if their foundational concepts were descriptively valid. Indeed, the concepts came to define "rational" choice, largely because if one agreed with the assumptions underlying them, then, logically (mathematically), one *should* make decisions in the prescribed manner. Presuming that the economic actors about whom they were theorizing were rational, certainly the most convenient presumption, easily led economists to the conclusion that their prescriptions were, in fact, descriptions of how those actors behave. This transmutation was made even more palatable by the realization that if maximization of expected utility is not descriptive, the usefulness of utility theory is substantially diminished, which weakens those aspects of economic theory that incorporate it. Therefore, convenience, necessity, and usage all argued for the descriptive validity of the maximization of expected utility. As a result, there was a shift from it being regarded as merely prescriptive to it being regarded as generally descriptive too.

The result of this shift was that economists talked and acted as though there is a descriptively valid "Law" of Maximization of Expected Utility, to

[1] The utility function is a psychophysical function that relates the psychological experience of worth, measured in utility, to the market value of the anticipated outcomes of a potential action, and usually measured in money or goods.

the effect: "*Unless constrained to do otherwise, people choose actions that offer the maximum expected payoff*." That is, this is how a hypothetical Economic Man, the economists' ideal, would make his choices, so it must be how rational people make theirs. And, it became common in both the scholarly literature and the more serious popular literature to offer explanations of a wide variety of human behaviors in these terms. Indeed, Gary Becker won the 1992 Nobel Prize in Economics for his analyses of behavior in economic terms (Becker, 1993), particularly his analysis of criminal behavior (Becker, 1968). In fact, the economic viewpoint has come to permeate modern thought, eclipsing previously dominant religious and psychodynamic explanations of why people do the things they do.

At about the same time that economic theory was adopting its Law of Maximization, psychologists were looking for alternatives to the Law of Effect and S→R conditioning as a way of explaining behavior. Thanks in large part to Ward Edwards (1954) they became aware of the economists' Law of Maximization and began to consider it as a substitute for the Law of Effect, particularly for deliberative decision making in risky circumstances. But, for psychologists, empiricism is the watchword. So, before accepting Maximization, they began an experimental examination of its descriptive validity, with discouraging results both for them and for the economic theories that relied on it.

Their research made it clear that utility theory does not accurately describe untutored decision makers' evaluations of worth, that probability theory only roughly describes untutored decision makers' doubt or uncertainty, and that even sophisticated versions of the Felicific Calculus do not adequately describe how untutored decision makers evaluate and choose from alternative courses of action (e.g., Fischoff, Goitein, & Shapira, 1983; Isenberg, 1984, 1986; Keren & Wagenaar, 1985, 1987; Wagenaar & Karen, 1988).

Let us be clear about what all of this means. The finding that untutored decision makers do not normally act to maximize expected utility does not mean that they do not act in what they perceive to be their self-interest. Neither does it mean that untutored decision makers never balance anticipated losses (costs) against anticipated gains (benefits) in deciding about actions. Nor does it mean that the Utilitarian's instructions for making decision are invalid; a tutored decision maker might profitably use some version of the Felicific Calculus, even expected utility, in a structured procedure such as decision analysis. The only thing that the experimental evidence proves is that the specific theories (utility theory and probability theory) and the decision criterion (Maximization of Expected Value) do not

account well for the decision behavior of untutored decision makers—of "natural" decision making.

Invalidation of Maximization raises the question: If untutored decision makers are not attempting to maximize expected utility, how exactly are they serving their self-interest? A surprisingly large number of answers have been offered (Starmer, 2000). For example, as early as 1955, the economist Herbert Simon suggested that instead of maximizing, decision makers frequently settle for the first option that is at least satisfactory, called "satisficing." This and other criteria received a good deal of attention but none supplanted maximizing as the predominant criterion of good decision making in economics.

Over the years, other answers have been advanced, one class of which attempts to retain the underlying logic of expected utility theory, including maximization, by exploring one or another alteration in the probabilities (e. g. Edwards, 1955, 1962) or utilities (e.g., Loomes & Sugden, 1982). The most prominent of this class of answers is Kahneman & Tversky's (1979) Prospect Theory, which introduced concepts (e.g., an editing function) that "psychologize" the expected utility formulation.[2] In the same vein, Causal Decision Theory (Armendt, 1986; Weirich, 2012) incorporates causality into the probability component of expected utility.

The advantage of these answers to the question about the criterion that people actually use to make decisions is that they make the components of expected value more psychologically plausible. The disadvantage is that, with the exception of "satisficing," they all retain some form of the maximization criterion, which simply is not viable regardless of it being the essence of "rational" decision making (Beach, Vlek & Wagenaar, 1988).

"Rational" is a loaded word. All that it means in this context is that if a decision maker agrees with the axioms of utility theory, he or she ought to make decisions the way the theory prescribes. But, decision makers often agree with the axioms without making decisions in the prescribed way. So, from the viewpoint of utility theory, they are behaving irrationally; which really adds little more than condescension and admonition to the discussion. The only way to move the discussion forward is to seriously consider the possibility that the decision makers' failure to do what Maximization says they ought to do is not because their decisions are irrational but because their decisions are made in some entirely different way.

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[2] Prospect Theory was later revised in light of work on rank-dependent expected utility (Quiggin, 1982) and re-named Cumulative Prospect Theory (Tversky and Kahneman, 1992).

Naturalistic Decision Making's Criterion: Goal Feasibility

Another answer to the question of the criterion that determine decisions comes from Naturalistic Decision Making, which assumes that the Law of Maximization is irrelevant, that decision makers are doing something else instead. There is no utility, no probability, and no maximization. The criterion is the feasibility of a selected course of action for solving a problem. For example, Klein's (1989; 1993) Recognition-primed Decisions model posits that context provides the decision maker with a definition of the goal or problem to be solved as well as information for accessing his or her past experience to determine a potentially successful course of action. Decision makers are seen as deliberative planners who are capable of using their imaginations to picture what might happen if they were to do this or that or something else and who are able to choose accordingly. Taking this further, Svenson (1992), Lipshitz (1993), and Montgomery (1993) suggested that before it is implemented, a chosen course of action is subject to tempering and reshaping in light of arguments for and against it. Competing options are weeded out by such arguments until a single, compelling course remains. All of this is a long way from Maximization.

TNT's Criterion: Discrepancy from Standards

Yet another answer is provided by TNT [and its predecessor, Image Theory (Beach & Mitchell, 1987, 1990)], in which decisions turn on the discrepancy between the expected future and the future dictated by the decision maker's enduring values and transient preferences (standards), which defines the expected future's desirability. The mechanism for appraisal is called the *discrepancy test*.[3]

Because the past is over and the present is fleeting, decisions are about the future**.** TNT characterizes these decisions as beginning with the future that is implied by the decision maker's causal knowledge about what led up to the present and what will happen next. Then he or she must (A) decide about the desirability of that implied future. If it is sufficiently undesirable, the decision maker must (B) decide upon a remedial course of action. This second decision requires a second decision this time about the desirability of the future that a candidate remedial course of action might achieve. If the action's expected future is desirable, it can be implemented to substitute its future for the undesirable expected future. If the action's expected future is undesirable, other courses of action must be considered, and so on until a

[3] Also known as the *compatibility test* in its earlier manifestations.

course action is found that has the potential to direct events away from the undesirable expected future and toward a desirable future—which is to say, toward a future that is compatible with (fits with, conforms to, does not violate) the decision maker's values and preferences.

Discrepancy. Discrepancy means that the expected future does not fit with or conform to the decision maker's values and preference—his or her standards. In practice this means that the forecasted future is assumed to conform to these standards until there is proof to the contrary and the proof is the degree to which the events in the expected future violate, are discrepant from, the decision maker's relevant standards. A *violation* is a negation, contradiction, contravention, prevention, retardation, or any similar form of interference with the realization of one of the decision maker's relevant standards.[4] Research indicates that violations are all-or-none (e.g., Beach & Strom, 1989). That is, below some degree of discrepancy between events in the expected future and the decision maker's relevant standards, the expected future is deemed to sufficiently congruent with them to warrant its acceptance; it is not threatening. Beyond that degree of discrepancy, the expected future is deemed to be too incongruent and therefore is threatening—the expected future is not what it should be. The critical level of discrepancy is called the standard's *violation threshold*.

The focus is on violations because it reflects what people in our research actually did and because it reflects a commonplace; people are more attuned to things that are wrong, things they dislike, than they are to things that are right—if only because things that are wrong are more directly diagnostic of future trouble (Essay #6). So, no matter how many desirable features something may have it only takes a few undesirable ones to make it unacceptable (Peeters, 1971; 2002; 2003). Additionally, because values and preferences reflect the way things should be, if they are in fact that way it is not remarkable and it certainly does not call for remedial action. Violations, on the other hand, indicate that something is wrong and that remedial action is needed. Moreover, if action can eliminate what is unacceptable, what remains is acceptable.

The discrepancy test consists of comparing a component event of the expected future, or the future offered by a course of action, with relevant standards and noting the discrepancy. If a discrepancy exceeds the standard's violation threshold, it counts as a violation, otherwise it does not. That is, the test is noncompensatory--nonviolations cannot compensate for violations. Overall discrepancy is the sum of the violations, each weighted by the primacy (importance to the decision maker) of the standard that is

[4] Violations are, in fact, violations of closure under transformation (Essay #3).

violated. Which is to say, overall discrepancy is zero when the expected future has no violations and decreases (is more and more negative) as the number of violations increases. The *decision criterion* is: If the weighted sum of the violations exceeds some absolute *rejection threshold*, the expected future is rejected as undesirable, i.e., as too incompatible with the decision maker's standards. If an expected future is not found to be undesirable, the decision is to allow it to unfold without interference. On the other hand, if it is found to be undesirable, action must be taken to make it acceptable. This requires the second decision about the expected future offered by successively considered remedial courses of action.

The discrepancy test has been subjected to more than 30 years of research. Starting in 1989, a series of laboratory studies examined the usefulness of the discrepancy test for understanding decisions. The general paradigm was to ask college students to make decisions about options such as entry-level jobs, rental rooms, or time-share condos.

One of the earliest studies (Beach & Strom, 1989) examined the role of violations and nonviolations in decisions. College students were asked to assume the role of a newly graduated student who is looking for a job (the future). The job seeker's preferences for 16 job characteristics (the desired future) were provided so all participants would be using the same standards. Then the students were presented with the features of different jobs for which he or she could apply (the action alternatives). Each job's features were listed on successive pages of a small booklet and there was a separate book for each job. The features on each page of a job's booklet did or did not violate one of the job seekers preferences (e.g., the jobseeker wanted to live in a large city; the violation was that the job was in a small city). Participants went through the pages of the book until they had seen enough to decide to reject the job or retain it for further consideration (the *choice set*). The order of violations and nonviolations for the various jobs was contrived to permit inferences about how the information was used to make the decision.

The results showed that rejection of jobs regularly occurred after observation of an average of four violations; that is, the average rejection threshold was four violations. There was no comparably consistent number of nonviolations for deciding to retain jobs for the choice set. In fact, nonviolations played no role at all in the decisions, a result that has been observed in subsequent research (e.g., Beach, Smith, Lundell, & Mitchell, 1988; Gilliland, Benson, & Schepers (1998); Ordonez, Benson & Beach (1999); Peeters, 2003; Potter & Beach, 1994ab; Rediker, Mitchell, Beach, & Beard, 1993). Taken together, these studies demonstrate the primacy of violations in the decision process and the existence of the rejection

threshold, two key concepts in the discrepancy test. Incidentally, follow-up studies showed that it is the number of violated features that determines the decision, not the proportion of features that are violated.[5]

In a study that pitted the discrepancy test against maximization of expected value, Potter and Beach (1994a) found that decision makers treated probabilities the same way they treated other features of the future. That is, they treated high probabilities (availability of an apartment) as nonviolations, which contributed nothing, and low probabilities as violations which added to overall discrepancy; they did not use either the high or the low probabilities in the multiplicative manner required by expected value. Seidl & Taub (1998) pitted the discrepancy test against Prospect Theory and reported that the discrepancy test best accounted for their data.

Research also has demonstrated that participants factor in standards' differential primacy (Beach, Puto, Heckler, Naylor, & Marble, 1996). And they respond to time constraints by increasing the speed with which they do the discrepancy test while decreasing the carefulness with which they do it, while raising their rejection thresholds so fewer options are rejected, lest good options get overlooked in the rush (Benson & Beach, 1996). In addition, participants ignore small discrepancies between standards and corresponding features of the expected futures but as the discrepancies increase there is a threshold above which they count as violations. This *violation threshold*, decreases as the importance of the feature increases (indicating less tolerance for violations) and as the number of other violations increases. That is, what might not otherwise qualify as a violation is likely to do so if the feature's importance increases for some reason or if other violations have already been observed (Benson, Mertens, & Beach, 2008).

The discrepancy test also has been examined outside the laboratory. For example, Beach, Smith, Lundell, & Mitchell (1988) studied business decisions of executives of two sports clothes manufacturing firms and found that the decisions could be accounted for by a simple (not weighted by standard priority) discrepancy test. Other applications include, audit decisions (Beach & Frederickson, 1989; Asare & Knechel, 1995), planning decisions

[5] There is a difference between appraisals that feed into decisions and decisions themselves. Thus, Pesta, Kass, & Dunegan (2005) found that decisions about promoting employees (an expected future offered by an action) relied solely on the employee's bad behavior (violations), as required by the discrepancy test. In contrast, they found that evaluative judgments about past performance relied on both bad behaviors (violations) and good behaviors (nonviolations). Gilliland, Benson, & Schepers (1998) obtained a similar difference between judgments and action decisions.

(Beach, DeBruyn, & Jungermann (1996), satisfaction with supervision (Bissell & Beach, 1996; Richmond, Bissell & Beach, 1998), job search and job selection (Stevens & Beach, 1996), selection of clients by audit firms (Asare, 1996), the effects of organizational culture (i.e., standards) on decisions (Weatherly & Beach, 1996), employee turnover (Lee & Mitchell, 1991; 1994), consumer decisions and social responsibility (Nelson, 1996), decisions about marketing and communication strategies (Puto & Heckler, 1996), career decisions (Stevens, 1996; Stevens & Beach, 1996), the constraints of general cultural standards on group decisions (Walsh, 1996), decisions about research and development progress (Rutten, Dorée, & Halman, 2013) and the assessment of leadership (Richmond, Bissell & Beach, 1998).

Paul Falzer and his colleagues, particularly Melissa Garman, have examined the discrepancy test in the context of medical decisions about treatment for chronic illnesses; schizophrenia and rheumatoid arthritis. In two studies (Falzer & Garman, 2010, 2012) the focus was on how physicians integrate patient-specific information into their use of treatment guidelines for schizophrenia. Falzer and Garman (2010) presented psychiatric residents with cases about which they made decisions about treatment recommendations. At issue was whether or not the residents endorsed the treatment guidelines, depending upon whether the information in the case was or was not discrepant on four factors (patient treatment adherence, progress, current condition, and likelihood of a good treatment outcome): Thus, the number of discrepancies could range from 0-4. It was found that the greater the number of discrepancies, the fewer the endorsements, with a rejection threshold between 0 and 1 violation. In a similar study (Falzer & Garman, 2012), residents decided on the likelihood that the patient would respond favorably to a recommended treatment a) if the treatment followed guideline recommendations, and b) if treatment departed from guideline recommendation. Standards were defined as patient-specific factors and violations were factors that failed to match the guideline; the number of violations could range from 0 to 3. It was found that the discrepancy test accounted for the decisions, with a rejection threshold of 2 violations. This study also examined primacy weighting and found that unequal weights predicted slightly better than equal weights.

In a third study (Falzer, Leventhal, et al, 2012), patients were the focus and their decisions were about whether or not to consider a change in their current treatment for rheumatoid arthritis. Interview data were gathered, among which was information about patients' expectations about their future under their current treatment in terms of consequences, emotions, and long-term impact. In addition, they were asked whether they were considering

a treatment change. It was found that violations of all three of the standards (consequences, emotions, impact) by their current treatment were required for a change to be considered and that unit weighting was sufficient—suggesting that all three standards were equally important.

Afterword

This, rather longwinded, essay has looked at the different decision criteria that define different views about decision making. It provides the segway to the next essay, which is about decision aids built upon TNT's discrepancy test.

ESSAY #11:
NARRATIVE-BASED DECISION AIDS

The first book on TNT (Beach, 2010) presented the nascent version of the theory in the first half and a model of TNT-based decision making in the second half. The second half also provided examples of TNT-based decision aids in the spirit of decision analysis and decision conferencing for conventional decision theory. Generally speaking, decision aids are technologies of varying complexity designed to help people clarify their expectations about the future and how they feel about them. And, if they'll feel bad about them, the aids can help them decide what to do about it. In this essay, we will bring the 2010 aids up to date in light of "modern-day" TNT (Essay #1).

As we have said previously, in TNT, decisions are about the degree to which the expected future deriving from your prime narrative differs from the future that would derive from your standards. That is, just as the prime narrative implies expected future events, your standards (your values and preferences) imply what those expected events must be to be desirable. The difference between an expected event and desired version of that event is called a *discrepancy*. A non-trivial discrepancy means that the expected event *violates* the standards that define desirability, which, because the future hasn't happened yet, constitutes a *threat* that when it gets here, won't be desirable. That is, a discrepancy between expectations and standards identifies a potential future violation, which is a threat. The overall threat of the entire expected future is a function of the identified potential violations (discrepancies) of its component expected events. The big decision is about whether its overall threat is so large that action must be taken to reduce the discrepancies, thereby reducing violations and threat.

The theoretical model for the decision is called the *discrepancy test* (Beach & Mitchell, 1990). TNT uses it for two kinds of decisions. The first is about whether the expected future is too threatening to be allowed to happen as expected. The second, which follows if the first decision is "yes, it's too threatening", is what to do about it.[1]

[1] The second decision, the action decision, also is made for individual expected events when their undesirability (discrepancies) is a major contributor to the overall

The Discrepancy Test

The test begins with the array of *expected events* that comprise features of the *expected future*. Each of these events is compared to a hypothetical *desired event*—what that expected event would be if it conformed to your standards. The absolute discrepancy between the two versions of the event is combined across all events in the expected future. If the total discrepancy is nontrivial, the future is allowed to happen. If the total is unacceptably large, action must be taken to make the actual future, when it arrives, as equivalent as possible to the desired future.

Trivial and Non-trivial Discrepancies

The word "nontrivial" in the last paragraph is important because it defines what qualifies as a violation and what doesn't. Imagine an interval around the desired state of an expected event. This is called an equivalence interval, or an EI (Beach, Beach, Carter & Barclay, 1974; Crocker, Mitchell & Beach, 1978), because an expected event that lies within it is only trivially different from its desired state. The event is "close enough," so it doesn't count as discrepant and, therefore doesn't count as a threatening violation of the underlying standard. Conversely, an expected event that lies outside the EI is nontrivially discrepant from the desired state and therefore counts as a threatening violation of the standard.

EI boundaries are fluid, particularly because transitory preferences make discrepancies that are trivial at one time or in one set of circumstances, non-trivial at another time or in other circumstances. And, the EI's boundaries may be asymmetric; it usually takes less badness to be too bad (a threat) than it takes goodness to be too good (also a threat). Because discrepancies are measured as absolute differences, valence (badness or goodness) is irrelevant—too much of either is bad. So, it all boils down to whether the expected event lies within the boundary and therefore is nonthreatening or lies outside and is threatening—and how far it lies outside, the further it is, the more threatening it is.

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undesirability (discrepancy) of the expected future as a whole. Repairing the expected future by repairing the most undesirable component events and leaving the others alone is common course of action, if only because it is quicker than repairing the whole expected future. But, including all this in our discussion adds a layer of complexity that makes presentation difficult, so we will ignore the details here.

Decision Aids

Decision aids seldom are used for simple decisions, but they can be valuable for decisions that involve numerous possible outcomes and for which a lot is at stake. Some are so complex that they require a technician's help, but others can be self-administered. They all reflect the model of decision making that their creators are convinced is the right way to make decisions.

As you might expect, decision aids based on TNT aren't quite the same as those based on other approaches to decision making. TNT's aids are considerably more modest than most of the others, if only because they aren't very technical. The measurements they require are largely subjective, are about how the decision maker sees the future, what he or she wants it to be, the discrepancy between the two, and what to do about the discrepancy. And, the results are more suggestions than prescriptions. On the other hand, anybody can use them. Most users find they help them think more clearly about the issues relevant to their decisions and they seem satisfied with the decisions they make after using them.[2]

TNT's Aiding Strategy

As is the case for almost all aids, TNT's strategy is to make a difficult decision less difficult by decomposing it into its component parts, assessing those parts, and recomposing the assessed parts into a suggested decision. The tool for doing this is the *decision sheet* in Figure 11-1.

First Example: A Yes/No Decision

Let's suppose that you have been thinking about your present job, wondering if it is leading anywhere and if you even care. As you ponder, you try to imagine the future; which is to say, you consider the future you can expect if you stick with your job for at least the next couple of years. Soon, you realize that you're going in circles, you can't seem to get your head around the issues. So, you drop by our office, asking for help. We give

[2] A professional decision analyst once remarked that most clients knew what they were going to do before they finished the analysis; they used it as a way of justifying their decision to themselves and others and for convincing others to go along with them. We have found this to be true using the aids we will describe, but people finish the exercise to see if it agrees with their intuitions. They almost always trust their intuitions more than they do the aid.

you a blank decision sheet like the one in Figure 11-1 and the instructions for filling it out. You go home, sit down with the beverage of your choice, and start to work.

- Begin by thinking about your expected future over the next two years. Imagine you have a crystal ball and if you looked into that ball, you'd see the future as it will be (not as you want it to be). Look at that future and write a short descriptive paragraph about what you see, describing it as you would to a friend. (Be as realistic and complete as you can, but don't get mired-down in the little stuff.) Then underline each distinct expected event in your description, i.e., each identifiable and nameable feature of the future that you and your crystal ball *expect* to happen.
- List the expected events (the significant components of your expected future if you keep your job) in the column on the left side of your decision sheet. Make sure everything pertinent is there and nothing is there that shouldn't be. Adjust the list accordingly and add anything that occurs to you while you're doing it.

Figure 11-1: Example of a decision sheet.

Option _____

Desired Future	**Importance I**	**Magnitude M**	**Impt X Mag IM**
1 _____	___	___	___
2 _____	___	___	___
.	.	.	.
.	.	.	.
n _____	.	.	.

n = _____

N = **n** x 9 = (____) **U** = Sum **IM** = (____)

The degree to which you think your expected future will be *undesirable*:

$\mathbf{D_u = (U \div N) =}$ _____**%**

The degree to which you think your expected future will be *desirable*:

$\mathbf{D_d = (100\% - D_u) =}$ _____**%**

- Count the number of expected events in your list (**n**) and multiply the total by 9. (Why 9 will be explained in a moment.) Then write the answer in the parentheses where it says **N** on the decision sheet.
- Now, consider each expected event on your list in terms of how *important* it is to you—how big a role it would play in making your future desirable whatever job you have, this job or a different one. *Then rate it for how important it is by assigning it a number from 1 to 3,* where 1 = low importance, 2 = medium importance, 3 = high importance). Write the number in the column labeled **I** for importance.
- Go back and consider each expected event in the first column in terms of what will be like if you keep your present job. *Then rate it for how different that is from how you would like it to be by assigning a number from 0 to 3,* where 0 means the expected event is "close enough" to what you would like it to be and 1 = small difference, 2 = medium difference, and 3 = big difference. Write the number in the column labeled **M** for the magnitude of the difference.
- For each expected event, multiply the numbers in columns **I** and **M** and write the product in the corresponding blank in the column labeled **IM**, on the far right of your sheet,
- Add up the numbers in the **IM** column and write the sum in the parentheses at the bottom of the column where it says **U**.
- Divide **U** by **N**, which yields $\mathbf{D_u}$, a decimal number that can be converted to a percentage by moving the decimal point two places to the right (e.g., .72 = 72%). That percentage is the degree to which you think your expected future will be *undesirable* if you stay in your job. Subtracting that percentage from 100% yields $\mathbf{D_d}$, the percentage to which you think your expected future will be *desirable* if you keep your job.[3]
- Sit down with your two percentages, $\mathbf{D_u}$ and $\mathbf{D_d}$, and think about what you want to do in light of them. If you still aren't sure what you want to do, think about adding to or subtracting from your list of expected events or changing some of your ratings. Or, maybe, you should consider waiting a while and doing the analysis again before committing yourself to keeping or leaving your job.

[3] D_u *and* D_d *are not probabilities*! They don't mean that your expected future has a probability of $\mathbf{D_u}$ of being undesirable and a probability of $\mathbf{D_d}$ of being desirable. No, No, No! Instead, if 0% is a wholly benign future and 100% is the most threatening possible version of that future, $\mathbf{D_u}$ and $\mathbf{D_d}$ tell you where your expected future lies between the two extremes.

Now, why divide **n** by 9? Because it equals the undesirability of an expected event that is maximally important (3 on the rating scale) but maximally discrepant from what you want it to be (also 3 on the scale); 3 x 3 = 9. Which is to say, a wholly undesirable expected event that is as undesirable as it could possibly be, would have a 9 in the right-hand **IM** column. If all **n** expected events were wholly undesirable, they all would have 9 in the **IM** column and the sum, **U**, would be 9 times **n**. On the other hand, if every expected event were wholly desirable, every entry in the **M** column would be 0, so that every entry in the **IM** column would also be 0 and the sum of the **IM** column, **U**, would be 0. This little bit of arithmetic provides us with the two ends of a scale with a completely desirable expected future at the left end, at 0, and a completely undesirable expected future at the right end, at 9**n**.[4]

The question is, where on this scale does your expected future lie? The answer requires a line with 0 on the left end and **N = 9n** on the right end and your **U** at the appropriate place between them. So, for example, if you listed 12 expected events on your decision sheet, the line would run from 0 at the left end to 12 x 9 = 108 at the right end. And, for example, if your **U** were 54, it would lie in the very center of the line, meaning that you feel your expected future in your present job is as desirable as it is undesirable; the next question is whether that is good enough for you to want to stay in your job.

Alternatively, you can do as we suggested above and compute $\mathbf{D_u}$, the percent to which your expected future is undesirable, by dividing 54 by 108, which equals 50%, the same answer you got with the line. If your **U** were 24 instead of 54, the $\mathbf{D_u}$ would be 24/108 = 22%, which would mean your expected future is only 22% undesirable and 78% desirable. Again, the question for you is whether that's good enough to stay in your job.

Second Example: A Two Option Choice Decision

Suppose that while you were pondering your future in your present job, you are offered a job at a firm on the other side of the city. Now you have a dilemma; stay with the old job or take the new job. So, you come back to our office and we give you a decision sheet just like the first one and tell you haul out your crystal ball and start thinking about what the future would be in two years if you took the new job and filling in a decision sheet as you

[4] Incidentally, 9 is called a "scaling constant"; it provides a unit for maintaining proportionality between entities, in this case, when there is no "natural" underlying scale for comparing them.

did before for your present job. (If this proves hard to do, you probably don't have enough information about the new job. So, learn more about it and then try again.)

After you've done the analysis for the new job and computed its percent undesirability and percent desirability, you are ready to make the choice. Let's focus on the percent desirability; if there is a meaningful (to you) difference between the desirability of the future offered by your present job (Figure 11-1) and the desirability of the new job (the new decision sheet). Consider choosing the most desirable job if the difference is big enough to make you comfortable with the choice.

Notice that you didn't directly compare the expected futures (or their component events) of the two jobs. Indeed, the two futures can be wildly different; apples and oranges. But they still can be compared in terms of their overall desirability, which was evaluated independently for each. This allows you to see, up front, if one or the other or both jobs are predominately desirable or undesirable. If one job's future is desirable and the other one's isn't, choose the one whose is. If both jobs' futures are undesirable, choose the more desirable of the two or look for a third option, do the analysis for it, and then choose the job that is the most desirable of the three. If none are desirable enough, keep looking.

Third Example: A Multiple Option Choice Decision

Assume that you found your new job more desirable than the old job. But before you accept the new job you have to make another decision. Your old job was within walking distance of your home, but the new job is across town. Because you are unwilling to move, which would necessitate transferring your children out of really great schools where they have lots of friends, you would have to commute. So, you must *make a decision* about how best to do it; each possible mode of transportation is an option (a plan of action) for getting to work and you need to choose one of them.

You have driven to work for jobs you've held in the past, and most of the people you know drive to work, so driving is an obvious option. But, you realize that, if nothing else, driving is expensive, so you think about it a little more and end up with three competing options: drive, transit, or carpool. The question is, which of the three is the best choice for achieving the future offered by your new job? If none are sufficiently desirable, you may have to re-think taking the new job.

To make the decision, you make out a decision sheet for each of the three options individually, beginning with driving (Figure 11-2). Do everything just as you did for earlier decision sheets—considering each of your three

options independently. After all three sheets are completed, compare the results and make your choice. First, eliminate the option with the lowest desirability percentage; it is inferior to the other two. Then make the choice between the two survivors just the way you did for the two jobs in the previous example.

No matter how many options you have to choose among, the best course is to eliminate all but the two with the largest desirability percentage, then choose between them.

A Two Option Choice Decision for Two Decision Makers

Turn now to a more complex decision. The first complexity is having two decision makers rather than one. The second is having more expected events in the futures offered by contending options. For most people, the more expected events there are, the more difficult it is to be confident about their ratings. Decision analysts usually solve this problem by breaking the expected events for an option into clusters, groups, and sets. The clusters are big bundles of the expected events that have a similar theme, groups are

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Figure 11-2: Decision sheet for a plan for commuting to a new job.

Option: Drive_____

Expected Events	**Importance I**	**Magnitude M**	**Impt x Mag IM**
Cost	3	3	9
Travel Time	3	1	2
Reliability	3	0	0
Comfort	3	0	0
Privacy	2	0	0
Traffic	3	3	9
Convenience	1	1	1
Safety	2	1	2
Environment	1	2	2

N = 9 x 9 = 81 **U** = 25

The degree to which you think your expected future will be *undesirable*:
D_u = (U ÷ N) = (25 ÷ 81) = 31%
The degree to which you think your expected future will be *desirable*:
D_d = (100% – D_u) = (100% - 31%) = 69%

bundles of more closely related expected events, and sets are bundles of highly related expected events. In Figure 11-3, the clusters are labeled with Roman numerals (I, II), the groups are labeled with capital letters (A, B, C. D, E), and the sets are labeled with numbers (1 to 19). The idea is that instead of wading into the evaluation of all 19 expected events in Figure 11-3, it makes the task easier if we break it down into smaller tasks. (Of course, in most decision analyses, the person who makes the evaluations and the person who does the computations are different persons—the decision maker and the decision analyst. So, when we describe the required computations, it makes things look more complicated than they normally would be for a real decision maker; he/she would just do the ratings and receive the results from the analysist, who does the math.)

Fran is a (fictitious) 33-year old woman who has been married for seven years to (equally fictitious) Herb, who is 38. They have one child, a 3-year old girl named Angela. Their marriage is sound, although Herb thinks they may have been drifting apart lately, largely because they both have demanding jobs that they like. Fran has a very responsible job at a cancer research laboratory, where her particular skills are central to the laboratory's ability to obtain research grants. She loves her job, although things become very stressful whenever existing grants come up for renewal or new applications must be submitted for funding. Herb was recently promoted to regional manager of the company for which he has worked for 7 years; a job that will demand even more of his time because he will have to do a lot of traveling.

If only because Fran's mother clearly wants more grandchildren, Herb and Fran have discussed having another child, but they never seem to get very far. They agree that if they are going to do it, it should be soon because they think four years is a good space between children. They both derive great satisfaction from raising Angela, although neither of them is home as much as they feel they should be. Angela has been in daycare since she was very small. As a result, she has great social skills and seems to have far more friends than either of her parents.

Figure 11-3: Decision sheet for Herb and Fran's decision about having another child.

Option: Don't Have Another Child

Expected Events	**Importance I**	**Magnitude M**	**Impt x Mag IM**
I. Us (3)			
A. Herb (3)			
1. Good Health (3)	1 27	1 0	1 0
2. Grow & Mature (2)	2 18	2 1	2 18
3. Fulfilling Job (3)	3 27	3 0	3 0
B. Fran (3)			
4. Good Health (3)	4 27	4 1	4 27
5. Grow & Mature (2)	5 18	5 2	5 36
6. Fulfilling Job (3)	6 27	6 0	6 0
C. Our Marriage (3)			
7. Material Well-being (3)	7 27	7 0	7 0
8. Becoming Closer (3)	8 27	8 2	8 54
9. Time together (2)	9 18	9 1	9 18
II. Angela, Relatives & Friends (3)			
D. Angela (3)			
10. Good Health (3)	10 27	10 1	10 27
11. Grow & Mature (3)	11 27	11 2	11 54
12. Good Childhood (3)	12 27	12 1	12 27
E. Relatives & Friends (2)			
13. Becoming Closer (2)	13 12	13 1	13 12
14. Time Together (1)	14 6	14 2	14 1

N = 14 x 81 = 1,134 **U** = Sum **IM** = 285

The degree to which you think your expected future will be *undesirable*:

$\mathbf{D_u = (U \div N) = (285 \div 1{,}134) = 25\%}$

The degree to which you think your expected future will be *desirable*:

$\mathbf{D_d = (100\% - D_u) = (100\% - 25\%) = 75\%}$

Last month Fran's sister gave birth to her third child, setting Fran's mother off again. As a consequence, Fran has begun to wonder aloud if they should stop avoiding the decision about another child; either decide to do it or decide not to do it and make clear to her mother what they decide.

The question Herb and Fran must answer is: Which option presents the more desirable future: having a second child or not having one? Here's what we'd tell Herb and Fran if they came to us for help making their decision.

Step #1: Decision Sheet for the Expected Future without a Second Child

- Think about how future will be if you *don't* have a second child. Get out your crystal ball and describe that future in writing, underlining each distinct expected event in your description, i.e., each identifiable and nameable event you expect to happen if you don't have a second child.
- Write each underlined event on a separate index card.
- Sort the cards into *groups* of similar events and give each group of cards an identifying label.
- Sort the labeled groups into larger clusters on the basis of their more global similarity and label the clusters.
- Write the labels and events in the column on the left of the decision sheet in Figure 11-3.
- Assign each cluster (I and II) a number from 1 to 3 to indicate how important its contents are to your future (1 = low importance and 3 = high importance).
- Assign each group (A, B, C) in each group a number from 1 to 3 to indicate how important its contents are to your future.
- Assign each expected event in each group (1 through 19) a number from 1 to 3 to indicate how important it is to your future.
- This time you evaluate **M** first and **I** second. So, for each of the 19 individual expected events in Figure 11-3, indicate the magnitude of the discrepancy, if any, between your expectation of what you think it will be and what you feel it should be (the desired state) by writing a number from 0 to 3 in the column labeled **M**. Assign a 0 (zero) to any expected event that will be close enough to what you need it to be and numbers from 1 to 3 (1 = small discrepancy and 3 = large discrepancy) to indicate how far each of the others will exceed by too much or fall too short of how it should be. Write the numbers in the column marked **M**.
- Calculate the importance of each expected event of the expected future relative to the other expected events and write it in the parentheses after each event:

- Multiply the rating you gave to each cluster (I, II) by the ratings you gave each group (A, B and, C) and then multiply the answer by the rating you gave the first expected event in Group A and write the answer in the column labeled **I**.
- Repeat for all expected events in Group A. Then do the same thing for the expected events in Groups B and C.
- For each event, multiply the number in the Importance column, **I**, by the number in the magnitude column, **M**, and write the product in the column labeled **IM**, on the far right of the decision sheet.
- Sum the numbers in the **IM** column, divide by (19 events x 3 max rating = 81), and move the decimal two places to the right to obtain $\mathbf{D_u}$, the undesirability of the expected future if you don't have a second child.[5] Subtracting $\mathbf{D_u}$ from 100 gives you $\mathbf{D_d}$, the desirability of that future.

Step #2: Decision Sheet for the Expected Future with a Second Child

- Create another decision sheet and go through the same procedure you just went through but this time for the expected future if you had a second child.

Step #3: Decision

- If one option's desirability percentage seems to you to be sufficiently larger than the others', choose it.
- If neither option's desirability percentage is very large, choose the one with the largest, but you might want to put off doing anything about it and repeat this second part of the analysis later on, in case something comes up that can make the expected future for having a second child either larger or smaller.
- If both options desirability percentages are large, select the one that is largest, but again, take your time.

Of course, this is just a fictional example, so we don't have to tell you what they did, you'll just have to figure out what you'd do if it were you. The whole point of any analysis is to think through the decision—what it

[5] The general rule is $\mathbf{Y^L\,n}$, where **n** is the number of expected events, **Y** is the largest discrepancy rating allowable, and the exponent **L** is 1 + the number of levels of events (one level in Figures 1 and 2, and three levels in Figure 3). The largest discrepancy rating allowable for all three figures is 3. Thus, the exponent on $\mathbf{Y^L}$ for Figures 1 and 2 is **L** = 1 + 1 level = 2, so $\mathbf{Y^L} = 3^2 = 9$. For Figure 3, **L** = 1 + 3 levels = 4, so $\mathbf{Y^L} = 3^4 = 81$).

means to stay with the expected status quo and what it means to change the status quo. The goal of using a decision aid is to expand your ability to think clearly so that when you sit down with that cup of coffee afterward, you can say to yourself, "Yes, that really is what I want to do."

Other Decisions

The examples given above are only a few of the kind of decisions people have to make about their futures. But all of them, even far more complicated ones, can be reduced to something similar to the examples. Remember, all decisions are about different versions of the future, about alternatives to the future you expect to happen as an implication of the past and present. The question isn't so much about how to strive for something better, although, indirectly, it is that. Mostly it is about how to avoid something worse, about avoiding a future that violates your standards and, therefore is threatening, to one degree or other. That is, it is largely about avoiding a future that will disappoint you.

These examples are all about personal decisions, but decisions for institutions are not dissimilar. The problem in that case is less about the decision, which can be analyzed like our examples, and more about getting a group of the institution's decision agents to agree on an expected future and on the ratings required by the aid. There are techniques for dealing with this, called decision conferencing, but they go beyond the scope of this discussion.

Some Rules of Thumb

The most difficult part of using a decision aid is making sure you include all the defining expected events. Fortunately, merely attempting to list them tends to make you think more deeply, which reveals the expected events that aren't immediately apparent. If you don't want to write a detailed description of the forecasted future (although we'd advise you to do it), you can simply list the expected events on a piece of paper as you think about the future. Then, when you find yourself thinking about things you've already thought about once or twice before, stop and arrange the expected events like we did in Figures 11-1 through 11-3.

In the course of arranging the expected events for the decision sheet, and subsequently evaluating them, you'll find that some of them are too much like others to warrant listing both and that some have been left out. Use your good sense to straighten things out, but always pay attention when your intuition tells you something doesn't fit right—that's a message from your

prime narrative and your standards. Keep revising until you feel comfortable with the list and its arrangement. Actually, this seldom takes as long as you might imagine.

Then start entering your evaluations on the decision sheet. As before, listen to your intuition. Discomfort about an evaluation means it probably isn't right. Sometimes it is a cue that the list of expected events isn't put together correctly and you therefore can't make a clean evaluation. If you think this is the problem, go back and repair the list of expected events or the groups to which they're assigned. Discomfort also is a cue that you really don't understand an expected event or that it in some way doesn't belong on the list; if so, think about it more and make the appropriate changes.

When you've done all the calculations, compared the options' desirability percentages, and made a decision, there is another little test you can do to help you know if the decision is right. Ask yourself how you would feel if the decision had come out the other way. If your analysis adequately reflects your thoughts about the various plans, you shouldn't have more than minor qualms about your decision. But, if you've fudged somewhere, or the analysis has left something out, you may not feel so comfortable—so it's back to the drawing board.

Finally, our use of 0 to 3 scales may seem to oversimplify measurement. But we've found that most people aren't able to reliably make subtle judgments about importance and magnitude, so using scales with numerous gradations doesn't add precision, it just adds the illusion of precision. That said, however, if you feel that you can make more nuanced judgments, you are not limited to the scales we've used in these examples. You can use any scales you wish, but remember that you have to adjust the scaling unit (the 9 and 81 in our examples) to fit the scale you use or the percentages at the end of the analysis won't make sense.

Afterword

Two points brought up by those who are encountering TNT for the first time: The first is the emphasis on discrepancies, which are defined as threats (see also Essay #6). Why not emphasize goals and striving instead of mitigating threats by diminishing discrepancies; it all seems so negative. The answer lies in the standards (values and preferences) that define the desired state of each expected event and the expected future as a whole. Because standards define what is good, appropriate, proper, etc., i.e., how the future should be, they are aspirational—they *are* the goals, the things you want. So, anything that meets those standards, is as good as it gets. And

standards are, by definition, the goals sought when action is taken to diminish or eliminate expected events that fail to meet them.

The second point is that the decision aids described above don't seem much like how people actually make decisions. The answer is that decision aids (not just ours) are not simulations of unaided decision making, they are designed to induce the decision maker to think about a decision in a different way. After all, if the usual way was working satisfactorily, there would be no need for an aid. This isn't to say that discrepancies aren't the basis of unaided decisions and action isn't undertaken to address those discrepancies, it is just that the discrepancy aid, all decorated with formulas and math, isn't a facsimile of how the decisions are normally made.

Even so, the decision aids described above may seem a bit rough and ready. But, remember, a decision is just the beginning of the process, not the end. Any decisions you make must be followed by real actions in a real world that changes rapidly, requiring more decisions to take the changes into account. Therefore, decision precision is a luxury, not a necessity. You just need enough to get you started in the right direction. Feedback will quickly swamp the original decision anyway, requiring adjustments to what you're doing and then adjustments to the adjustments many times over before you get to a desirable future, either the one you started with or something different, but still desirable. That 'something different' is often a compromise and, while maybe not the best, it may be the best you can achieve with the time and resources available. Too, the precise nature of your desired future probably will change, often as a result of your own actions. All of which is to say, it is not necessary for narrative-based decision paradigms to tell you precisely what to do to make the future desirable, it simply has to help you figure out how to get started.

PART VI

SOME APPLICATIONS OF TNT

The two essays in Part VI are drawn from our consulting and teaching experience. The first was prompted by an invitation to critique an article about scenario planning for businesses and the second derives from our management consulting experience.

ESSAY #12:
BIASES AND BARRIERS

As described in Essay #10, one of the major controversies in the study of human cognition has been about so-called heuristics and biases (Tversky & Kahneman, 1974). We say "so-called", not because they don't exist but because they aren't what they seem. Most of them were "discovered" in the course of work on judgments about probabilities and related tasks in which research participant's judgments were compared to the prescriptions of probability theory, sampling theory, and the like—called "normative" models. The idea, as you already know from the earlier essay, is that people can't think in terms of probability, so they use short-cuts, called heuristics, which result in errors (deviations from the prescriptions of the normative models). The errors are consistent enough to be called biases rather than merely mistakes.

In this essay, we will attempt to show how TNT offers an alternative interpretation of biases as well as other performance barriers. For context, we'll use a real-world task, scenario planning, to explore how TNT deals with the frequently encountered cognitive and procedural barriers, including biases, to satisfactory execution of the planning task.[1] First, let us put things in context:

Scenario Planning

In 1993, Paul Schoemaker introduced the basic concepts of scenario planning to behavioral scientists. Citing a history of war gaming by the military during the Cold War and the adoption of strategic planning by industry in the 1970's, he used his experience at a large international oil company to compile a set of procedures for generating plausible, causally coherent shared narratives about alternative possible futures—called scenarios. The procedures are designed to expand groups of planners' thinking about ways in which the future might unfold. Since Schoemaker's initial article, scenario planning has developed in a variety of ways, but in all of them the focus is on expanding understanding the unique futures of various organizations

[1] This essay is based upon Beach (2021).

within government and industry. Planning usually is done by a group whose members represent different constituencies within the organization, different opinions, different priorities, and different requirements, which means that its final product requires negotiation. Fruitful negotiation is made easier when all members of the group clearly understand what is being negotiated. Scenario planning can help: Its plausible and coherent stories about possible futures makes it easily understood by users. Its consideration of alternative futures allows uncertainty to be represented by ambiguity, a familiar concept, rather than numerical probabilities. And its focus on a spectrum of possibilities rather than a single path forward increases awareness of possible surprises.

Even with these advantages, planners are subject to cognitive constraints that limit their abilities to adequately expand their thinking about the future. Schoemaker (1993, 1995) identified these as the difficulty of overcoming the limiting influence of past experience on imagination, problems with conceiving of alternatives that are markedly different from existing expectations about the future, resistance to integrating information that conflicts with existing views, and obstacles to entertaining more than a small number of alternatives simultaneously. He also cites difficulties from what in scenario planning have become known as cognitive barriers and are known in the larger literature, chiefly the decision making literature, as cognitive errors or biases (Tversky & Kahneman, 1974). Subsequently, Bradfield (2008) and Schirrmeister, Goring, & Warnke (2020) further examined the cognitive barriers encountered in scenario planning.

Cognitive and Process Barriers

One purpose of a theory is to tie things together in a coherent story. This means that the things we know and that the new things we learn should fit within it; i.e., the theory should be able to accommodate them both. In what follows, we will examine how TNT accommodates (accounts for, explains) some things that are already known about the domain of scenario planning and decision making. The knowledge of interest is observed barriers, both *cognitive barriers* (mostly the familiar biases) and *process barriers*.

TNT accommodates cognitive and process barriers as reflections of its normal operating characteristics. In what follows the barriers identified as common in scenario planning by Bradfield (2008) and Schirrmeister, et al. (2020) are grouped under the operating characteristics of TNT that best account for them: the prime narrative, causality, the implied future, coherence, and standards.

Prime Narrative

- *Barriers: Belief perseverance, and experience bias, and overconfidence bias*:
  Your prime narrative is all that you have to understand what is going on. It is your intuitive truth, the world as you know it. As a result, it takes a good deal of counter-evidence (usually in the form of failed predictions, but also what you learn from other sources) to make you doubt its truth. It also means that when you have a good deal of experience in some area and your narrative surrounding this experience is coherent, you presume that your intuitions are valid.
  Your "overconfidence" is actually a judgment made by other people when their certainty about your expectations for the future is less than yours.

Causality

- *Barrier: Causal information bias*:
  Because causal information is congruent with the causal logic of TNT it is more easily integrated into your prime narrative, and any derived narratives, than is non-causal information such as lists or discrete facts. This leads you to favor information in which causality is clear.

The Implied Future

- *Barrier: Extrapolation bias*:
  Because the future advances quickly, efficiency and speed recommend simple extrapolation of the prime narrative so threats can be promptly detected and mitigated before they materialize. To an outsider this may look like an undue preference for a simple story, but even at the price of oversimplification it is largely the most efficient way to operate.

Coherence

- *Barrier: Belief bias*:
  You tend to believe coherent explanations even when closer examination might reveal them to be incorrect. This reflects your dependency on the coherence and plausibility of your prime and derived narratives for determining your confidence in their truth and the accuracy of their implied futures. As above, the goal is efficiency rather than total accuracy.
- *Barrier: Confirmation bias*:
  Because confirming information usually increases, or has the potential to increase your prime narrative's coherence, it is preferred to disconfirming information which usually does the opposite, or has the potential to do so. Moreover, confirming information is more

easily reconciled with your prime narrative than disconfirming information because it requires no (or fewer) changes to accommodate it. Although disconfirming information always signals that there is a problem with your prime narrative and its implied future, it often fails to make clear precisely where the problem lies.

- *Barrier: Hindsight bias*:
  When the future becomes the present, it is incorporated into your prime narrative. When it is different from what had been expected, your prime narrative must change to accommodate it—automatically but not necessarily easily. Insofar as its inclusion does not much alter your prime narrative's coherence, a mispredicted event fits the narrative, implying it could as well have been part of the prime narrative all along.
- *Barrier: Ambiguity aversion*:
  Inclusion of ambiguous information in your prime narrative decreases its coherence, which you resist. Moreover, you are less willing to believe another's narrative when its coherence is low (Wolfe & Pennington, 2000).

Standards

- *Barrier: Bias toward conformity to social hierarchy and/or to majority opinion; groupthink*:
  Standards are about social norms insofar as they are absorbed as personal values and preferences. In most groups, failure to conform to the values and preferences of the majority of the group members (i.e., the group's social norms) results in active or passive expulsion. People who have a high value for inclusion are particularly apt to conform because failure to do so is threatening.
- *Barrier: Taboo*:
  Standards based upon both social norms and personal values and preferences frequently mark particular topics and words (events) as threatening, with the accompanying emotional discomfort. Mitigation is provided by avoiding them.

Unaccounted for

- *Barrier: Representativeness and availability:*
  These are methods (heuristics) for assessing the probabilities of events, rather than biases. They are not accounted for by TNT because TNT is based on causality; probability in the frequentistic sense is not a part of the theory although certainty may be modeled well by Bayesian processes (e.g., Pearl, 2000, Phillips, 2005) and similar mixes of probability and causality (e.g., Suppes, 1970, Price 1991). Of course, you can learn probability theory, but what you

learn is a narrative about it and not a mechanism of narrative thought, which is causal. Representativeness and availability are assumed to be used by statistically untrained people (or trained people who do not access their training) when they are asked to estimate the probability of something: they must rely upon whatever means they have to supply their interrogator with an answer—which turns out to be representativeness, availability, etc. (Whether they are pertinent to scenario planning depends upon how certainty/probability is handled. In Schoemaker's (1993, 1995) version, for example, probability is by-passed in favor of ambiguity in the form of multiple scenarios.)

These attributions of biases to constructs in TNT are not ironclad. Closer examination might argue for revisions. But the point of the exercise is to suggest how TNT might provide a conceptual framework for understanding biases as operating characteristics of narrative thought.

Process Barriers

Process barriers are beliefs and behaviors that impede smooth negotiation of a product that the planning group's members can support and that serves the needs of the client who tasked them with developing it. It has been our observation, having served on innumerable planning committees, task forces, SWOT analyses and the like, that everyone arrives with fairly fixed ideas about the threats the organization faces, how those threats came to be, and what to do about them. After all, they were selected to serve because they are knowledgeable. The typical result is that group meetings are about negotiating these prior views into a common story for the report that will go to the CEO, Dean, or whoever initiated the effort. Unless there is someone, usually an outsider or someone who outranks everyone else in the group, who can insist on a broader view, the negotiated story tends to fall within the range of the individual stories the participants brought with them, or not far outside. In some sense this parochialism is the most serious bias of all and the reason scenario planning, decision aiding, and such disciplines exist. Therefore, in what follows, the focus will be on how narrative thinking promotes this narrowness; i.e., how TNT accounts for it. To give the discussion structure, we will cast it within Schoemaker's (1995; 2020) ten-step description of the scenario planning process; acknowledging, as he did, that many variations occur in practice.

Schoemaker's first two steps are about framing the task and setting boundaries. They are largely factual: identifying the client and the issues of

interest to that client, defining the time frame, the scope, the pertinent parts of the future that are beyond the organization's control, etc. All of these establish what is relevant to the scenario planning exercise and what is not. TNT accounts for this as specifying the aspects of the participants' knowledge (their prime narratives) that are relevant to the task and defining the boundaries for imagination of alternative futures.[2]

The third step invites participants to use their knowledge to identify trends that reflect the momentum of the past and its implications for the organization's future, which necessarily includes how those trends shaped the organization's present. It is here that negotiation begins, as each participant consults his or her prime narrative's content about the organization and tells the other participants about the trends contained in it. In TNT, trends are strong causal chains within the individual's prime narrative. The stronger the chains, the more easily they are identified. This suggests that more subtle trends, weaker chains, are easily overlooked. But it is just these less obvious trends that might produce unexpected future events; after all, the results of strong trends are more predictable. Indeed, knowledgeable participants are all likely to identify the same strong trends; the real insights may lie in the weak trends they either overlook or regard as unworthy of being disclosed to the group. So, from the TNT viewpoint, as all the trends suggested by the participants begin to be melded into a common narrative, care must be taken to ferret out the weak trends. Many may be too idiosyncratic to particular participants to be of much value, but some hidden gems may emerge.

The fourth step requires identification of weak links within the identified trends. In TNT, weak links may simply result from not knowing enough or being uncertain about things that are known. If so, pertinent information (hopefully causal and narrative in form, for easy assimilation) can either weaken the links more, making the trend less a trend, or it can strengthen the links, making the trend more certain for predicting the future. If pertinent information does not exist, it may have to be created through research. If it exists and is not readily available, then, subject to costs, efforts should be made to obtain it.

The fifth step brings imagination to the forefront. It requires participants to use the results from steps one through four in imagining different combinations of ways in which the identified trends could lead to different futures and to refine the most reasonable of these combinations into coherent

[2] Note that there is an analog of this activity in design research called "programming", which is defined as "problem seeking", not "problem solving". In every case, the object of this exercise is to "close under transformation" the arena of future activity and investigation.

narratives—plausible scenarios. TNT views each of these combinations is a provisionally derived narrative; a conjectured scenario about the past, present, and future. The more deviant these scenarios are from a participant's intuitive prime narrative and its predicted future, the less that participant will believe them—either their own or others'. The result is that the scenarios that are most widely believed within the group are likely to become part of the communally arrived-at scenarios. But, widely believed scenarios are pretty predictable, pretty pedestrian. Focusing on them may leave behind the less plausible, maybe even weird and exotic, but potentially more informative scenarios. After all, the goal is to anticipate the unexpected and the unexpected is unexpected precisely because, in foresight, it is implausible.

The sixth step is to factor the predictable actions of internal and external actors into the scenarios, where actors are other people or inanimate forces such as weather or economic trends. Arguably, this should be part of the fifth step; predicted actions are provisionals.[3]

The seventh step, is to examine how the organization's current strategy would fare if the future were to unfold as described in each of the negotiated scenarios and to identify where it would fail. TNT views failures as threats in the scenarios' predicted futures that the current strategy would either fail to correct or would make worse.

The eighth step is to revise the current strategy to make it more flexible if its failures are minor. If they are major, the ninth step is to create a set of alternative versions of strategy, one for each scenario. These form a stockpile, if you will, from which an appropriate version can be drawn and implemented when early indications suggest that the future is in fact unfolding in the way described by one or the other of the scenarios. The tenth step is to identify those early indications for each scenario.

Lists, steps, and the like, make things seem clear, rational, and straightforward. In the event, of course, they seldom are so clear cut. To some degree, this is because, as was noted above, every member of the planning group arrives with a different version of the past—their own back-story about what led up to what they see as going on at the moment; what they believe to be the prelude to what will happen in the future. Even when considering the past from the organization's viewpoint, the participant's own experiences are mixed in. Even though they share a great deal of knowledge about the organization and its past, everyone is starting from a different point and, left on their own, will end at different points. To mitigate

[3] In TNT, this corresponds to hypothetical "closing under transformation" a new set of possible futures, as trends and their interactions and identified externalities are considered.

this, veridical historical information should be introduced as a provisional that, together with negotiation, moves participants toward a common back-story for which there is sufficient agreement to get on with the task (Bradfield, Derbyshire, & Wright, 2005; Schoemaker, 2020).

Participation and Buy-in

Even when a negotiated past can be developed, every participant knows it is a compromise and different from their own truth about the past, and, therefore, different from their truth about the present and future. TNT tells us that their intuitive truth is not easily compromised or abandoned. The best intention to cooperate and participate in the exercise falters when the group's scenario differs greatly from what the participant's own prime narrative is telling them. Big differences are threatening; they imply that what the participant believes to be true is either false or negotiable, which seldom is acceptable. The resulting resistance may be interpreted by others as stubbornness or uncooperativeness. Of course, it may be either or both, but most often it is genuine discomfort with what is being proposed. This makes negotiations about the present and future difficult, but it sometimes can be overcome by emphasizing the genuine commonalities among the competing alternatives and minimizing all but the crucial differences. Even then, it can be difficult to get buy-in from everybody because compromise is unlikely to produce highly coherent alternatives that are acceptably close to everybody's intuitive truth.

Communication

Recall that in TNT, derived narratives are abridged, working versions of the prime narrative that are used for thinking and for communication with others. But, abridgment loses detail, with the result that participants often have difficulty in precisely expressing their underlying intuitive understanding—including precisely justifying their own and their constituents' standards and priorities. Because every participant in the group has this difficulty, to one degree or other, there is bound to be a good deal of misunderstanding and conflict in negotiations to create scenarios that are agreed upon by everyone.

Part of this misunderstanding can be remedied by the introduction of solid information to both inform and to stimulate participants' imaginations and to guide the process so everyone is on roughly the same page. This works because the information provides common provisionals for everyone to use in generating alternatives. The question is how to present that

information in a way that it is useful. Both TNT and universal experience suggest that the answer is to present it in narrative form if at all possible—making clear how it fits, both temporally and causally, into a storyline about what happened in the past and how that led to the present and what it means for the future. As every teacher can testify, information introduced in the context of a story, in narrative form, is far more likely to be understood, retained, and used than when it is presented in some other way. Visual materials (graphs, diagrams, tables, etc.) help, but at best they augment rather than replace the story.

Decision Making

Much of the above reflects the TNT description of decision making, but it is so important, so much else turns up on it, that it is worth a final review. TNT decisions are different from traditional descriptions of decisions; everything is based on comparisons and discrepancies rather than probabilities and utilities. Normally it proceeds in two steps; decisions about discrepancies between the prime narrative's implied future and the decision maker's standards, followed by decisions about which actions will eliminate those discrepancies. This is the case both for an individual's private decisions and his or her decisions in the workplace, except in the workplace, the standards are a mix of his or her own and the organization's standards; part of being a decision maker for an organization is a willingness to use its standards.[4]

Every derived narrative (scenario), both the participant's own and everyone else's', ends up being compared with the participant's prime narrative. The comparisons are rapid, done on the fly as the conversation progresses, but in each case, discrepancies are detected and decisions are made. Any scenario that is significantly different from the participant's prime narrative and its future sets off alarms because it clearly does not fit the facts as he or she knows them. Greater leniency may be tolerated in group tasks, such as planning, but even then, too much is still too much. The result can be genuine disagreement about the plausibility of proposed scenarios. But, this disagreement can be beneficial when it shows participants that other, presumably respected, participants legitimately hold differing views. In a sense, this is like a failed prediction, which is feedback that the prime narrative needs revision.

[4] An organization's standards are contained in both its stated goals and policies and in its culture (Beach, et al., 1988).

Afterword

Group decision exercises have become commonplace since their introduction in the late 1980's. As we said in an earlier essay, decision conferencing (e.g., Phillips, 1989) is an industry in itself. Scenario planning is too. They both involve similar group processes and dynamics but the goal for scenario planning is a bit different, a bit broader—less about preferences and risk and more about expectations about the future and the required actions. Both encounter the problems listed above and both have to work around them. The goal of this essay was to suggest how TNT might provide fresh insights into the nature of these problems, possibly even suggesting new ways of approaching them.

Essay # 13:
TNT in Management

This essay has two purposes. First, it is an attempt to do what its title promises, describe the role of narrative in management. Second, it is an attempt to describe how the prime and derived narratives work in a social setting. We'll return to the first purpose in a moment, but let's begin with the second one.

Prime and Derived Narratives

Recall that the prime narrative is the temporal/causal structuring of your past, present, and future experience. It is your basic reality and, in effect, your intuitive truth about how the world works—not a model, per se, but an extremely detailed story. Derived narratives are abridged portions of the prime narrative, where the particular portion of interest is dictated by the circumstances in which the derived narrative is being used. Derived narratives are what you use to think and what you use to communicate the content of your prime narratives (your understanding of the world) to others. And, what you think and what you and others communicate stimulates your senses and their senses, becomes your and their perceived present, and then is integrated into your and their prime narratives, changing them in the process. This is how your thoughts influence your own understanding as well as how your communications influence other people's understanding and how theirs influences yours.

Of course, everybody's experience is different so everybody has their own unique prime narrative. As a result, their derived narratives differ from those of the people around them. By and large, communication is an attempt to make the other people's prime narratives, and thus their derived narratives, more like one's own—to make them think and talk like you. To the degree that the others come to agree with you (is convinced), the attempt is successful. In some abstract sense, the communications within a group of people can be seen as a pooling of derivations from their respective prime narratives in attempt to increase the uniformity among their prime narratives. In the long haul, increased uniformity means decreased disagreement and strife, which usually is a good thing for any group that

must live or work together. It means that everyone has pretty much the same understanding of how the group got where it is and what can be expected to happen as a result. One function of any leader is to increase this mutual understanding by fostering communications that will increase the uniformity of those portions of everyone's prime narrative that are key to cooperation and teamwork directed at a common goal.

Management

That said, let's move on to the role of prime and derived narratives in two areas of management: managing organizational change and managing employees.[1]

Managing Organizational Change

Consider the following widely accepted principles for managing organizational change.

1. *Assess* the organization's external and internal environments and specify needed changes.
2. Understand the organization's *culture* and if it impedes progress, work to change it.
3. Create a *vision* for the organization's future
4. Lay out a *plan* of action for moving the organization toward the envisioned future.
5. *Implement* the plan and monitor progress.
6. *Institutionalize* achieved changes.

Now consider these principles from the TNT viewpoint; Change management must focus on understanding and changing one's own and others' prime narratives about what is happening (the present), what is going to happen (expectations), and what to do about it (behavior) if what is going to happen is undesirable.

Assessment: Presuming that you are the manager in question, assessment requires gathering information about what is happening in the world around the organization and within the organization itself. This information is integrated into your prime narrative as a description of what happened in the past that led to how things are now and what can be expected to happen if nothing is changed.

[1] Beach (2018) contains a more detailed version of this essay

For example, suppose the Human Resources (HR) department of your organization reports increasing difficulty finding skilled job applicants. Further, in the course of assessing the organization's external environment, you come to believe (prime narrative) that the state legislature's repeated cuts to education budgets (past) are leading to cutbacks in advanced math and science courses (present), and that more cuts and even fewer courses are in the offing (future threat). This prompts you to act. First, you see if HR's criteria are right for the jobs or are more demanding than necessary. Depending on what you learn, hiring criteria could be changed, jobs could be redesigned to fit applicants' skills, remedial training programs could be set up, and/or you could work with other organizations in similar straits to lobby the legislature to increase school funding.

Suppose that the consistent failure of job applicants to possess required skills led you to believe (prime narrative) that the legislature's cut-backs were the cause of the problem. The danger is that once this cause is identified and woven into the prime narrative, it becomes a fact—it is assumed to be the right cause, even if it is not, because the prime narrative is your basic truth. But, maybe the real cause is simpler. Perhaps the advanced courses were eliminated because students did not sign up for them. Perhaps this was because nobody advised them to do so. If a bit more digging showed this to be the case (feedback that changes the prime narrative), mitigating future threat by lobbying the legislature is less appropriate than working with educators to correct deficits in advising and finding ways to reinstate the courses. In short, misidentification of causes may lead to futile solutions even though they allow the prime narrative to remain plausible and coherent and therefore believable.

However, for the sake of argument, let us assume you have accurately identified present and future problems, what caused them, as well as what can be expected to happen if they are not addressed.

Culture: When problems exist or are looming, your first action should be to see if the organization has the resources to deal with them—personnel, skills, tools, etc. But equally important are resources supplied by the organization's culture.

Culture is a narrative that is shared by the organization's members—i.e., integrated into their prime narratives. It usually describes how the organization got started, what it is now, and what it is striving to become. It sets standards about what actions and goals are legitimate, and what are not. That is, it sets standards about how resources are legitimately to be used, what members of the organization can legitimately expect of each other, what constitutes legitimate power for management and how that power is to be legitimately exercised. It also sets standards about what employee

behaviors are legitimate, and therefore acceptable, and how acceptable behaviors will be rewarded and unacceptable behaviors will be punished.

Because the culture is shared, everyone understands the standards it sets even if it never is written down. Indeed, cultural standards may be at variance with official statements, but they almost always prevail. And, the more plausible, coherent, and engrained in everyone' prime narrative the culture is, the more impervious it is to efforts to change it. This is beneficial in that it provides consistency over time but it is detrimental when change is needed.

Successful solution of an organization's internal problems almost always requires understanding which features of the culture support change and which do not. It is the latter that almost always lead to changes in resource allocations, procedures, and power structures. All of which are disruptive and provoke resistance; people tend to stick with the old culture because it is plausibly and coherently integrated into their prime narratives. The leader's job is to induce cultural change, to change the part if the prime narrative pertaining to who we are and what we are striving to become, in order to minimize or remove obstacles to the solution of the organization's problems.

Vision: Culture change is best begun by offering a better narrative about a desirable future, called the vision, and a plan for attaining it. This vision uses the aforementioned assessment to identify what is wrong and what will happen if nothing is done, as well as what could be attained if the proper steps are taken in time. It must emphasize the salvageable aspects of the existing culture; "We won't betray our principles, but if we work hard, etc., this is what we can become." That is, the vision always is an extension of some of the bedrock standards in the existing culture because that is what makes working to achieve the vision worthwhile. But, it also makes clear what aspects of the culture have to change and why. That is, it makes clear what expectations and behaviors must change and how that is going to make things better.

Plans: Once the assessment identifies the problems and the vision identifies the desirable future that will be attained when those problems are eliminated, it is necessary to lay out a plan to make it happen. It is surprising how often managers think that all that is required is to identify the problem and state what its solution will produce and somehow employees will work it out from there. But, of course, you need a plausible, coherent story about how the organization will go from where it is to where it should be; from the problems it faces to the envisioned future. Failure to articulate a plausible, coherent plan leaves everyone in limbo. They know what is wrong and they know what a good future looks like, but they don't know

what to do. They need a step-by-step plan about how we'll do this first and then this and then either this or that depending on what happened and so on. Of course, the plan will have to change as conditions change, as the effects of prior behaviors either work or fail, but the core remains the same—getting from here to where we want to be.

Implementation: As the plan turns into action, feedback about its success is key to keeping it on track. This requires that both progress and success must be clearly defined and the means of measuring both of them must be specified. Doing this requires a story that tells everyone how to differentiate progress from regress or stagnation (benchmarks or mileposts or some similar label) and how we will deal with setbacks (plans, B, C, and D). And, equally important, it tells everyone what constitutes success, preparing them to understand that it seldom is total and often looks rather different from what it was originally envisioned.

Institutionalization: Your job isn't done after some approximation to success is achieved. The stronger the old culture—the more coherently it fits into everyone's prime narrative—the greater the tendency to drift back to how things were before the change. This means that the old problems may creep back in and little if anything will have been accomplished. This must be combated by creating a follow-through story, a derived narrative about the change itself. This is a mini-history about how the organization confronted its problems, how it strove to overcome them, how it succeeded, and how that success sets it up to deal with problems in the future. The latter is important because the organization's internal and external environments are in constant flux and new problems are inevitable. Strengthening the new culture with this follow-through story institutionalizes the entire sequence of development: assessment, vision, planning, and implementation with an eye to change as a constant rather than merely the reaction to threats.

The theme of the foregoing is narrative at every level. Assessments have to be plausible, coherent narratives if they are to be taken seriously. Culture is an existing narrative that can aid or hinder attempts to instigate change. Vision is a narrative about a desirable future, but it won't be accepted unless it is reasonably clear that you can get there from here or if "there" is too amorphous. A plan is a narrative about the explicit steps for getting from here to there and is usually appended to the vision narrative to reinforce its plausibility. The implementation narrative often is unique to the different jobs that contribute to the overall effort—to the cogs in the machine. But, at all levels, implementation narratives too must be plausible (reasonable steps toward the vision) and coherent (lacking in ambiguous choice points for the individual implementer). Finally, the follow-through narrative has to be incorporable into the culture narrative as the story of how we prevented

catastrophe and how this victory tells us to remain vigilant and flexible so we can prevail over new potential catastrophes. And every one of these narratives, these stories about our problems, their solutions, and the organization's future, are attempts to induce change in the job segment of everyone's prime narrative.

Managing Employees

The narratives discussed above are rather abstract, or at least on some higher plane than the ones to be discussed next. Those were about guiding the organization as it confronts and overcomes internal and external problems. These are about individual employees and groups of employees acting as a sub-unit of the larger organization. Those were about being an executive, these are about being a boss.

Once again, we start with some broadly accepted principles for managing employees.

1. Actively *lead*.
2. Understand one's own and one's employee's work-related *expectations*.
3. Anticipate one's own and one's employees' *emotions*.
4. Translate expectations into clear performance *standards*.
5. Evaluate *problems* that arise from unmet expectations and solve them.

As was the case for managing organizational change, changing your and their prime narrative is key to managing employees. But, in this case, the principles listed above identify segments of a fairly unitary job-related narrative that every boss and every employee has as part of a larger segment of the prime narrative that is about their respective jobs and about each other. But, bosses' and employees' prime narratives are shaped by their different viewpoints. The boss sees things from the viewpoint of how each employee contributes to the unit's performance and the employee sees things from his/her own viewpoint and the viewpoint of those with whom he/she works. It is this difference in viewpoints, and the resulting differences in prime narratives, that leads to mismatched expectations and resulting conflicts that are an unfortunate feature of any activity involving human beings, particularly those within the hierarchical structure that characterizes most modern organizations.

So, let us look at these components of the bosses' and employees' prime narratives that are about their jobs.

Lead: You, as a boss, have a segment in your prime narrative about your job; how you should go about doing your job. Some bosses' segment might be laissez-faire dealings with employees; perhaps articulating goals and leaving the methods up to the employees. Another's might be to establish friendships with employees and motivating them on a personal level. Still another's might be using the authority and power inherent in being the boss to direct through fiat and motivate through threat. Or, make semi-economic deals with employees—they do their jobs and don't make trouble in exchange for specific rewards. None of these is particularly attractive but they all are common.

Expectations: Every employee's prime narrative has a component about how you, as their boss, should do your job. Research shows that the greater the mismatch between how bosses are seen as doing their jobs and employees' expectations about how they should do them, the lower employees' reported satisfaction with the organization (Richmond, Bissell, & Beach, 1998). That is, if their boss doesn't behave like they think a boss should behave, it makes the whole organization less attractive, perhaps because it makes everything more difficult and unpleasant. Low satisfaction with the organization can impair motivation and, depending upon the ease of moving to another job, contribute to employee attrition.

Just as employees have beliefs (prime narrative) about how their bosses should do their jobs, they each have a belief about their own job and its place in the overall scheme of things. This is about how they came to have the job and how things have developed since then, what the job entails, what obstacles it faces, what constitutes good job performance, and so on. You, as their boss, have complementary beliefs about each job under your purview, although these center more on functions and performance than the nitty-gritty of actually doing the job. Mismatches between these two components of the respective prime narratives result in unmet expectations on both sides. Sometimes these unmet expectations can be resolved by mutual willingness to understand the other's beliefs, characterized by the common phrase, "I'm trying to understand where you're coming from." But, good will aside, severe failures to meet the boss' expectations may be fatal for the employee because the boss has the power.

In fact, power and how it is legitimately exercised is a major component of the prime narrative's job segment, for both you and your employees because it is part of the organization's culture and because it is part of everyday interactions. For employees, the component is about power relative to you, the boss—what either of you can legitimately ask of the other—and about how you should exercise your power. It also is about power relative to other employees. If their power component matches your

power component and the power components of their co-workers, everybody's expectations are met and things go smoothly. But mismatches are a major source of workplace conflict. Perceived excessive or illegitimate use of power by a boss or co-worker is interpreted as bullying. Perceived underuse of power is interpreted as weakness. Bullying breeds resentment and retaliation. Weakness invites exploitation and usurpation.

Finally, everyone's, including yours, prime narrative's job segment has a component about his or her job relative to other aspects of his or her life. On the one hand, this component is important because it determines the degree of commitment, energy, and time you or the others will willingly devote to your jobs. On the other hand, it is important because it determines the balance each person will strive to achieve in his or her life and, therefore, is part of his or her larger narrative and self-concept.

Emotions: The most important emotions are those that arise from violated expectations or the anticipation of violations. Bosses often are stunned by the strength of employees' emotional reactions to what seem to them to be justifiable demands. Similarly, employees often are surprised when their bosses react emotionally to what seem to them to be reasonable actions on their part. Although these supposedly justifiable demands may be legitimate in terms of the boss' prime narrative, they violate the employee's expectations. Similarly, what is reasonable in light of the employee's prime narrative violates the boss' expectations. The resulting emotional reactions seem unprompted and incomprehensible to those on the receiving end. Most organizations try to negate emotions in the name of "professionalism." But this just keeps the peace in the short run because it doesn't address the underlying problem, of which the emotions are merely symptoms. It doesn't address the mismatch between the bosses' and the employees' job narratives and the resulting violations of expectations.

Standards: The boss' prime narrative's job segment has a component about each employee's job and how it contributes to the larger enterprise that dictates his or her expectations about the employee's behaviors and about what constitutes good job performance. Of course, the employee's prime narrative's component about his or her job does the same thing. Once again, the problem is that the two may not agree. When this happens, the boss' violated expectations often generate strong emotions that the employee finds difficult to understand; after all he or she was doing what his or her prime narrative indicated should be done. In this case it usually boils down to finding a way to make the employee's prime narrative more like the boss'; the boss holds the power. But, too often this unilateral solution is unsuccessful. If the employee faces obstacles that the boss' prime narrative segment about the job doesn't include, no amount of force or

persuasion are going to make the two narratives match. The boss must somehow be informed about the obstacles and help in their removal or he or she must change his or her prime narrative to take them into account.

Many, many years ago, when one of us (LRB) was head of a psychology department, he fired a receptionist about whom everyone had been complaining. Later, when he tried to compose a job description to advertise for a replacement, it became clear that the job was so badly designed that nobody could have done it well. It became equally clear that his narrative about her job had been badly flawed: he simply didn't know what was involved, and by attribution of her apparently poor performance to inherent incompetence was baseless and insulting. Even worse, his sole standard for evaluating her job performance was that there should not be any complaints. In short, he was a rotten boss for that poor woman and, because she was already gone, there was nothing he could do to make things right.[2]

Problems and Solutions: Boss' prime narratives often have different timelines than do employees. This becomes apparent in the difference in what is regarded as prompt identification of problems and prompt solution of those problems. Bosses are more likely to detect systemic problems, especially if the dysfunction centers on particular employees or groups of employees, and less likely to detect more specific obstacles to good individual or unit performance. And, when they detect the latter, they often are more measured in their responses because their narrative contains a bigger picture than employees' do, so they see how removing obstacles for one employee may impose new ones for another. Employees' narratives are just the opposite. They quickly detect local obstacles and the repercussions because they see the immediate negative consequences. The result is that bosses feel that employees want solutions too quickly, without regard to the complexities and employees feel that bosses don't understand their problems or simply don't care.

The result of this mismatch is a mismatch in expectations, with all the attendant emotions and the complications that strong emotions can give rise to. The antidote is to create trust (another emotion) between bosses and employees that the other is well intended and is willing to tolerate some degree of frustration in order to make things run more smoothly. Part of this is establishing a mutual understanding (similar prime narratives and standards) about what constitutes fairness in regard to solutions to the problems.

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[2] It got a little better when, a few months later, he met the woman on the street and she thanked him for firing her from that awful job, because she had quickly found another that was far better. He was happy for her, but he still knew he hadn't handled things well.

Making fairness part of employees' prime narratives is difficult. Talk is insufficient; actions are everything. A history of procedurally fair decisions, even if the results weren't always what the employees regard as fair, is the bedrock. This allows employees' prime narratives to include the good record of past decisions when setting expectations about future decisions. If there isn't sufficient history, or if it is spotty, the narrative will lack plausibility and coherence and expectations will reflect these structural defects in the form of decreased trust and tentative behaviors. At its extreme, decreased trust means that every decision will be doubted, every change resisted, and the boss-employee relationship will become contentious and confrontational. And all that conflict decreases the energy that can be devoted to improving the bosses', employees', and organization's performance.

Afterword

All of what has been said above about change management and being a boss can be said without recourse to anything about narratives. It has been done in countless textbooks and management seminars. But identifying these seemingly different management and supervisory principles as reflections of peoples' prime narratives underscores a basic lesson: Fundamentally, managing organizations and people is about managing one's own and others' prime narratives and the expectations and behaviors that derive from them. In short, thinking in terms of narratives provides a more plausible and coherent viewpoint about managing than is afforded by thinking in terms of discrete managerial responsibilities.

PART VII

SOME IMPLICATIONS OF TNT

Each of the three previous books we have written about TNT has ended with analyses of real-world issues in terms of the theory. We'll close this book the same way.

Essay #14:
Scams, Conspiracies, and Hoaxes

In this essay, we will examine ways in which narrative thinking makes people vulnerable to manipulation and what TNT has to say about it.[1] Scams are different from conspiracy theories, which are different from hoaxes, but all three are based on lies (fake derived narratives), which is the reason we've included them in the same essay. These lies are communicated to you face-to-face or through some sort of intermediary medium, like the internet. If they are not too different from your prime narrative's existing content, and if the source is credible, they can be easily absorbed into your prime narrative without unduly reducing its coherence. Once there, the initial lies form a base for absorption of even more deviant lies that follow. At some point the corruption of your prime narrative is great enough to influence its implications for the future and, therefore, your actions.

Of course, an expected future predicated on lies is bound to be wrong. In a normal, fact-based environment, this would be sufficient to change the prime narrative by nullifying or isolating its corrupt parts. And this usually happens with scams when you realize you have been had. But, it doesn't necessarily happen with lie-based conspiracies or hoaxes. Later in the essay, we'll see why.

Scams

The Arizona Daily Star, Tucson's daily newspaper, employs an investigative reporter whose work, all on its own, justifies the price of a subscription. His name is Tim Steller and he generally limits himself to local skullduggery. But a while back, he described a scam that had local ties but was perpetrated nationwide (Steller, 2020). It involved solicitation of funds for building a piece of the politically fraught wall between the U.S. and Mexico on a section of private land. In fairness, the funds actually paid for more than four miles of wall, but it cost only about half of the roughly $25 million that was raised. A large chunk of the remainder ended up in the pockets of the people who ran the fund, which was called We Build the

[1] Be warned, this essay is unabashedly liberal and partisan.

Wall, even though they routinely assured donors that every penny would go toward wall construction. The scheme was publicly revealed to be a scam upon the arrest of, among others, a prominent political figure, Steve Bannon, and another man with Tucson ties, Brian Kolfage, who is a decorated war hero who was badly wounded in Iraq.[2]

Steller had previously known about We Build the Wall because he had been the recipient of frequent solicitations. He described one such solicitation that warned of a potential "surge" in immigrants when the pandemic lockdown was eased. The message said, in part, "That's why We Build the Wall is raising $500,000 over the next 30 days to Stop the Surge, and we need your support today." The suggestion, of course, was that the organization and its wall could save the country from the threat of inundation if the recipient donated money so it could do its job.

Threat, Savior, Instrument, Price

The underlying structure of a scam is a fairly simple story: Threat/savior/instrument/price. In the case of We Build the Wall, the threat was The Surge, the savior was the scammers, the instrument of salvation was the wall they would build, and the price of salvation was a donation. This is not much different from a legitimate transaction in which someone pays an agent to mitigate a perceived threat before it can cause harm—e.g., you pay your dentist to fill a cavity before it causes pain or a roofer to prevent leaks. What makes it a scam is the difference between the information the scammers have and the information the victims have: The scammers may or may not know, or care, about the real magnitude of the threat, but they present it as dire. They may or may not know, or care, about the potential efficacy of their own efforts at salvation and/or the efficacy of their proposed instrument of salvation, but they present both as sure-fire solutions. What they do know, and care, about, however, is the money they will skim from the donations.

The victims, on the other hand, know what they read in their newspapers and see on TV, which has become part of their prime narratives. The narrative the scammers tell them is enough like what they already know to make what they're told seem plausible. If the scammers are themselves credible, the victims easily accept what they are told. Thus, because We Build the Wall was fronted by a prominent political figure and a celebrated

[2] Bannon and Kolfage were arrested in 2020 and charged with conspiracy to commit mail fraud and money laundering. Bannon was pardoned by President Trump before he could be tried; as we write Kolfage has yet to go to trial.

war hero, victims assumed the legitimacy of the solicitation and the information in it. They were distressed by the threat, accepted the claimed efficacy of the savior and the instrument, and they willingly payed the relatively modest price of salvation by making a donation.

Steller went on to draw a parallel with Donald Trump's 2016 election campaign: As with We Build the Wall, the amplified fear was the general human distrust of Other and of a lurking fear of inundation by immigrant people of color. [In the campaign's case, there also were explicit claims that immigrants were the source of crime and disease, that immigration would undermine the currently prevailing (i.e., White) culture, and that the job market would be flooded with cheap labor.] In both cases, a savior and the mechanism for salvation were offered. In the campaign's case, Mr. Trump, was the savior and in both cases the border wall was the instrument of salvation. Too, in both cases, the price was donations (and, in the campaign's case, votes). What made both cases into scams was that there was (is) no credible evidence that a wall would have more than a minimal effect on illegal immigration, most of which takes place at or near established ports of entry rather than in the hot, barren desert or rough, mountainous terrain.

Steller then turned to a third example. The National Rifle Association assured gun owners that the government would void their "Second amendment rights" and confiscate their guns unless someone stopped it. The threat was the government, the savior was the NRA, the instrument was lawsuits and political action, and the price was membership dues and donations. What made this a scam was the inflation of the government threat to gun ownership and diversion of money from the fees and donations to provide luxuries for the organization's executives. (The organization and its officers subsequently came under legal scrutiny for fraud by the State of New York. Their attempt to declare Chapter 11 bankruptcy in the State of Texas, to which the headquarters would be moved and the proposed reincorporated as a non-profit, was rebuffed by a Texas judge at New York's request.)

Steller's goal was to produce a topical article for the newspaper and stir up a little "good trouble" while doing so. But his observations seem to us to extend far beyond his three examples. Some of us can remember U.S. Senator Joseph McCarthy and the wholesale purging of the U.S. government and of education to rid them of suspected communists, communist sympathizers, and supposedly blackmailable homosexuals. McCarthy and his followers presented the threat as communists undermining the U.S. government, abetted by "fellow travelers" in colleges and universities. The savior was the Senator and like-minded politicians and "patriots". The mechanism was loyalty oaths and a "cleansing" of the bureaucracy and higher education. The price was allowing the McCarthyites virtually

unlimited power and notoriety. In the end, the threat proved minor, essentially nonexistent, and an exhausted public tired of McCarthy and his crusade. But the damage had been done. Countless lives were ruined and careers destroyed. Perhaps worse, the seeds of distrust in government and fear of what would later be christened "the deep state" had been firmly planted. Unfortunately, it was just another in a long line of episodes in American history in which lies prevail until the underlying scam is revealed and the country comes to its senses—only to do it all over again later on.

These scams are dramatic, but we have all become so accustomed to lesser scams that we scarcely give them a thought. If you are like us, you delete half your phone messages because they are scams.[3] The current favorite claims that some amount of money will be withdrawn from your bank account (the threat) for some service or product that you supposedly ordered unless you call the phone number they caller supplies. We presume that if you were to call, you would be asked for your credit card or bank account number (price) so they (savior/instrument) can "clear up the misunderstanding". Of course, were you to comply, your credit card bill would balloon or your bank account would be raided. Another favorite claims that your "software license" will expire if you do not call them back and pay to renew it. We never do and it never does.

How to Run a Scam

Here is what TNT has to say about scams; and it isn't pretty. Mostly, it's about how to be a successful scammer, not about how to avoid being scammed. Indeed, avoidance simply boils down to the rather toothless admonition to be skeptical and careful and never give your credit card or bank information to a stranger. No big insight there.

On the other hand, TNT unfortunately has quite a bit to say about how to succeed at scamming. The first step is to understand that, humans, like all creatures, have evolved to be hypersensitive to potential future harm, to threats (Essay #6). This usually is a strength because it allows us to anticipate harm and ward it off before it happens. But it also makes us vulnerable to false or overblown threats, hence to scams.

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[3] There is considerable confusion about cons and scams. It seems to us that a con (short for confidence scheme) turns on promoting the victims greed and a scam turns on promoting his or her fear of loss. Surely, there is a fine line between greed for gain and fear of loss—one could fear not receiving the gain, which, from a TNT viewpoint, makes them much the same. TNT treats potential loss of opportunity as potentially as threatening as any other expected danger.

The second step is to understand the victim's existing beliefs and expectations, his or her prime narrative, and to present the threat as a coherent extension of it; if the threat already is part of their narrative's expected future, so much the better. Then you must establish your credentials as a savior and the efficacy of your instrument of salvation. This is reasonably easy if the victim has no information other than what you present or if what you present is congruent, if inflated, with what they are learning from other sources. Finally, you must establish the price; it can be left to the victim's discretion or you may suggest/demand some amount. In the latter case, it must be proportional to the degree of threat and the claimed efficacy of the remedy.

In all of this, it is important to maintain a coherent fake narrative. The biggest danger is overreach; complicating the story until it loses its plausibility. One of us (JW) received an email claiming that the sender had hacked his computer, actually quoting the first five symbols of the password. They demanded about $3000 in Bitcoin be sent to a web address or all sorts of bad things would happen. Understandably, he was greatly alarmed and, if he had had had any Bitcoin, he might have sent it. But then came the overreach. They went on to say that they had compromising photos of him and printouts of exchanges he'd had on sexually-oriented chat sites. Because he knew these things simply couldn't exist, the whole thing unraveled. It had to be a scam. And, it was; the due date passed, nothing happened. (And yes, he changed his password.)

The lesson here is that coherence is crucial. The whole story must hang together and be compatible with prior beliefs (the prime narrative) or the victim will remain unpersuaded. But, that, after all, is precisely what successful scammers excel at doing—telling a coherent, plausible story that justifies their request for payment. In this they are simply doing what anyone in sales does, they simply stretch the truth a bit more. *Caveat Emptor.*

Conspiracies

When unexpected things happen, especially bad things, one's first thought is, "Why?" TNT tells us this is because we believe that effects have causes and that the key to combating bad things is to understand what causes them. Absent knowledge of the real causes, we often settle for anything that makes a satisfying story—a coherent prime narrative. A conspiracy theory is a coherent narrative that supplies causes for the bad things we see happening (it supplies the "Why?") and, sometimes, gives us supposed a handle on changing them before they get worse.

Conspiracy theories are particularly suited for explanations of situations in which real causes are complex, little understood by anyone, not just ourselves, and can be linked to a plausible villain(s). They are a more complicated version of accounting for bad things by attributing them to the devil, nature, or fate.[4]

Conspiracy theories have two origins. One is spontaneous, in that it is part of the culture of which one is a member; Christian culture attributes evil to Satan, just as political cultures attribute evil to their opponents. These ready-made villains can be brought out when needed, supplying the cause for events that otherwise are a mystery. Mystery can be fun in art and literature, but not in real-life, because it reveals incoherence in one's prime narrative—the mysterious events do not fit comfortably with what one already knows/believes and forcing them simply reduces the prime narrative's coherence. Reduced coherence is itself a bad thing because it increases uncertainty (a negative emotion) about the future. The value of identifying a villain, be it an individual or a cabal, is that fits the cause and effect rules required by the prime narrative, allowing retention of its coherence and of your certainty about the implied future. And, knowing who to fear allows you to take steps to avoid or block actions meant to harm you.

The second origin of conspiracy theories is bad actors. These are people who make up and promulgate conspiracy theories, either because they find their own theories plausible and believe them, because they derive satisfaction from fooling people, or because they can make money—often lots of money (Oreskes & Conway, 2010). In the first case, they generate villains and plots that satisfy their own "Why?" and want to share it with others—essentially a generous act even if not everyone views it that way. In the second case, they generate villains and plots because it allows them to manipulate other people, a supremely ungenerous act.

If people who believe conspiracy theories don't act on them, essentially no harm is done—everyone has a right to believe any crazy thing they need to satisfy their "Why?" But, if belief turns into action, if attempts are made to mitigate the conspiratorial threat, the results can be worse than what prompts them. Misguided action can be Illegal—like assaults, riots, or bombings. Or they can be seeming legal but have misguided results—like pressing for legislation that discriminates against innocent people and writes injustice into law. So, conspiracy theories about China intentionally creating and spreading Covid 19, led to assaults on Asian Americans on the streets

[4] Chance is seldom a satisfactory "Why?" for causal creatures like humans. It usually is reserved for when nothing else makes sense.

of American cities. So, conspiracy theories about the 2020 presidential election being "stolen", led to the storming of the U.S. Capital Building, with some people getting killed and others going to jail. So, conspiracy theories about Covid 19 vaccines being dangerous led to fewer people being immunized than could have been and the unnecessary prolongation of the Covid pandemic and its economic, social, and health impacts (see below for more about the pandemic).

In short, other people's use of conspiracy theories to answer their questions about what caused the things they see as threats can become dangerous for everyone else. This danger may never materialize, conspiracy believers don't necessarily act on their beliefs, especially if the cost could be high (itself a threat). But, the mere fact that the potential is there is threatening to the rest of us. One job of government, at all levels, is to protect its citizens from threats from other citizens. The question is how?

Efforts to mitigate threats rooted in conspiracy theories usually rely heavily, or exclusively, upon presentation of contradicting information. That this doesn't work very well is attested to by the numbers of people who cling to the theories, even in the face of facts. In part this is because it is hard to prove a negative—no matter how many contrary facts you can muster, there always is the possibility that you are simply ignorant or that your facts are wrong or that things have changed. Indeed, a good conspiracy evades factfinders, that's why it is a conspiracy instead of an out-in-the-open movement, agenda, program, or initiative.

And it is here that TNT sheds light: The best remedy for a good conspiracy theory is a better story than the one it tells.[5] A better story is one that builds upon what people already believe—up to where the conspiracy theory kicks in. From that point onward, the better story must, above all, be coherent and its implications for the future must be clear and unthreatening. It can incorporate scientific facts, but they must be assimilated into the story, not merely stuck onto it....they have to be part of the flow (Wolfe & Pennington, 2000). Finally, the better story should not be contentious, it accomplishes little by confronting the conspiracy theory. It doesn't need to win the battle, it needs to make the battle unnecessary by giving people a better narrative for thinking and talking about things.

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[5] In the same vein, Reiff (2021) argues that liberals must tell a better story, they "must abandon the cool, detached and technocratic language that liberals often employ today, and start using language and promoting liberal narratives that are as compelling as the rhetoric and illiberal narratives being promoted by the other side." Green & Brock (20002) have demonstrated that immersive stories have more impact on beliefs than fact-based counter arguments.

A better story also is a more interesting story. Research suggests that one feature of conspiracy theories is that they're entertaining (van Prooijen, 2021; vaan Proijen, Ligthart, Rosema, & Xu, 2021). If nothing else, they often are dramatic, interesting, exciting, and attention-grabbing (e.g., Democratic big-wigs involved in pedophilia, etc.). Indeed, people endorse stronger conspiratorial theories when an event is described in an interesting rather than boring way.

So, begin with what people already believe, as background and a starting point. Construct the pathway from this to the implied future by drawing on the narratives of people who don't believe the conspiracy theory, but not as counterarguments. Rather, using these other people's narratives, assemble an interesting, dramatic, but still accurate and straightforward, story that reaches from there to here to the future. Something so clear and simple that it can't be misunderstood but that is interesting and exciting and attention-grabbing. This may take some tinkering to get the presentation just right, but accuracy must not be compromised. Once the better story is constructed it must be spread far and wide, so it becomes the new normative belief—the collective story of what happened, is happening, and will happen.[6]

Hoaxes (and Hoaxes about Hoaxes)

Humans are fragile creatures. We are assaulted by things so small we can't see them and threatened by things so big we can't comprehend them. We are soft, fuzzy, and vulnerable, with little but our intellect to protect us against an indifferent, even hostile, world. Yet, as a species, we have thrived to the point that we sometimes think ourselves invincible. And then reality steps in.

One such reality is the periodic outbreaks of new diseases. As we write this, the world is beginning another year of battling Covid 19 and its variants, deadly corona viruses that swept out of China and quickly enveloped all but the most remote corners of the earth. After some initial false steps, most

[6] After we wrote this, a study was published (van Baar, Halpern, & Friedman-Hall, 2021) showing that people who hold extremely liberal or extremely conservative views are less tolerant of uncertainty that people who hold more temperate views. We suspect that extreme views usually reflect more detailed causal and coherent underlying narratives than temperate views, which require less elaborate justification. Another very recent study (Martel, Buhrmester, et al., 2021)) suggests that part of strong belief is identification of one's self as a believer. It may be that the only way to overcome this is to highlight the discrepancy between one's standards and the implications of the challenged views.

governments sought to inform their citizens about the threat and require them to take specific precautions to protect against it.

It was remarkable how quickly and widely the precautions were adopted. As though a switch were flipped and we all were on high alert. There were the usual naysayers and self-proclaimed rebels, of course. But, most of us understood the threat and willingly did what needed to be done, hoping that it was temporary and life would soon return to normal. In doing so, we tended to overlook how remarkable, yet characteristic, what we were doing actually was. Remarkable, in that it happened so quickly and broadly. Characteristic, in that our response to this threat was an amplified version of what we all do all the time, even in normal times, in a world full of things that can harm us; we try to mitigate the threat.

Each day, each of us (us and you and everybody else) incorporated the things we learned about the COVID virus into our respective prime narratives about what was happening in the world, in our own lives, and in the lives of those around us. For most of us, the narrative was straightforward, if unsettling: past events (Wuhan, international travelers) caused present events (pandemic) which implied a threatening future (illness and possible death). Threat mitigation involved following recommended safeguards and avoiding social contact until there was a vaccine, and then getting the vaccine, then the booster, when they were available. Even so, we knew that many people would become sick and some would die; there have been pandemics before and this one is the latest, not the last. We also knew that authorities could be faulted for failure to plan and slowness to respond, but nobody really was to blame for the pandemic itself—not the Chinese, not the travelers, and not the politicians.

But, this reasonable assessment of the situation and this patient response to it was not for everybody. The naysayers and rebels, urged on by a few self-serving public figures, refused to acknowledge that the threat was real. Their story was that the whole thing was a hoax, a politically motivated deception. The illness, if it existed at all, was relatively benign—no worse than the flu (which, they failed to note, is frequently deadly). Requiring people to wear masks, maintain social distance, and avoid social gatherings until they got vaccinated was nothing but an excuse for government, at every level, to interfere with people's lives and deny their freedom. Some even went so far as to say that the illness was real and serious, but that it was deliberately introduced by a foreign power or a cabal of domestic evildoers to suppress freedom and take power. Intentionally or not, the claim that there was a Covid hoax, itself became a hoax.

There were different versions of what the supposed Covid hoax entailed, and why. Some were more extreme than others, but they all had their fans;

far more than one might have thought. The question is why? And, of course, the answer lies in narrative.

Those who had experienced Covid first hand and survived, knew how dreadful it was. But, most of what the majority knew came from the media rather than personal experience. Like a war half way around the world, it did not have the immediacy and compellingness that personal experience would have had. Moreover, responsible news sources avoided sensationalism and stuck to scientific facts and informed medical opinion. Even though this made their news stories rather dry and uncompelling, most people understood the attempts at restraint, appreciated the nuance, and lived with the resulting ambiguity. Others, however, found nuance and ambiguity intolerable. They needed vivid causes and stark effects; a bit of drama with the trauma. And there were less restrained media sources willing to fill their need for clarity at the price of distorting their understanding. This distortion, in turn, distorted their choices of actions to combat what they saw as the real threat—the masks, distancing, crowd avoidance, and the vaccine—not the virus. It also led to disparagement of the Covid experts and their advice, as well as physical threats against them. The apex was reached when vaccines became available and many of these people refused them. Even though they were a minority of the population, their actions contributed to the extension of the sickness and death, for far longer than it would otherwise would have been.

Just as we saw with conspiracies, believing the pandemic was a hoax resisted corrective information. The authorities relied primarily on presentation of medical information and statistics to build a reasoned counter-argument to the hoax theories. You might think that facts presented by scientists and physicians, whose job is to discover truth, would have had an impact. But, you'd be wrong. Dahlstrom (2021) suggests two reasons why scientists and physicians may well have the least suitable for the job. First, their facts often failed to match anything in most people's experience (their prime narratives) about the virus or anything else. Second, they frequently offered straightforward, point-by-point contradiction of the hoax theory, so their story was simply the flip side of the hoax story. This approach seldom is effective because its only message is "it ain't necessarily so", which is weak. Second, scientists and physicians are trained to avoid overstating their results and to acknowledge all the provisos and conditions that limit their data's generalization; more research is always needed. Their well-intended hesitancy often was interpreted as lack of conviction, undermining the very argument they are trying to make. If you confront a coherent, in-your-face story about a hoax with isolated facts hesitatingly presented, you really can't expect anything to change. The *only* way to prevail is to present a better

story than the hoax story can provide: Accurate, short, simple, focused on a vivid personal threat, with straightforward steps for avoiding it.

Afterword

It would be nice if TNT provided a clear strategy for dealing with scams, conspiracies, and hoaxes, but it doesn't. In fact, it provides a better strategy for those who would perpetrate them, which is a bit discouraging. Its only good advice, build a better story, may seem weak, but it really is deeper than it appears. For example, it suggests that instead of leaving the battle in the hands of Covid researchers and physicians, a good advertising agency should have been put in charge. Maybe its role should be soft-peddled, but advertising folks specialize in convincing messages. They know how to sell an idea so that people are willing to act on it. If you'll notice, every TV commercial is a little story that builds on what you already believe, adds to it, predicts a dower future if you don't do anything but promises rosier future if you do what they prescribe. In short, they tell one story and present a better one, all in 30 seconds.

Essay #15:
Thought Disorders

This essay was prompted by an article by Alex Riley (2021) about the *P-factor*, a relatively new idea among mental health scientists. That is the name for growing evidence suggesting a common underlying condition for mental disorders, or, as we prefer, for thought disorders.[1] It is, of course, a controversial idea, some critics simply dismiss it as statistical artifact, although that certainly doesn't explain all the data. We haven't got a stake in this so won't take sides, but the research that gave rise to the P-factor is important for anyone studying cognition and is relevant to TNT.

As you probably know, diagnosis of thought disorders uses exhibited behaviors (symptoms), including self-report, to identify a category in the DSM-5 classification manual.[2] Each category describes symptoms, related disorders, usual age of onset, gender specificity, common treatments and outcomes, etc. To be useful, the categories in any taxonomy, including this one, must be at least moderately independent. But the DSM-5 categories exhibit a good deal of overlap in the symptoms that define them, making definitive diagnosis difficult. Moreover, many patients' diagnoses change over time, as their symptoms change (e.g., Caspi, et al. 2014, 2020). Both of these observations, and others like them, suggest to some researchers that the symptoms are an expression of some underlying state or condition, which they call the P-factor.[3] The idea, of course, is that the P-factor predisposes some people to thought disorder(s), which means that it should be the target of treatment rather than the clusters of symptoms that define the diagnostic categories.

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[1] It seems inappropriate to use the term "mental disorders" in a book about TNT, given that the theory does away with an agent mind. In its place, and to a large degree because it is thoughts and how people express them that are at the core of things, we use the "thought disorders".

[2] DSM-5, published by the American Psychiatric Association, is the standard manual in the United States but ICD-11, published by the World Health Organization, is commonly used elsewhere.

[3] Riley also notes the neuroscience findings that brain activity often is much the same for differently diagnosed disorders.

But how do you get a handle on the P-factor?—there is no P-factor test. Maybe the best that can be done is, in fact, already being done—treating it indirectly by treating the individual disorders of which it is the cause. If so, it isn't working very well. Psychiatry and related disciplines don't seem to have had a meaningful impact on the prevalence of thought disorders, either through prevention or treatment, and no diagnostic tests of the form common in medicine have been developed (Cuthbert, 2013).[4]

However, the fact that thought disorders generally begin at a fairly early age suggests another strategy might be available. If you can't cure the P-factor, perhaps you can reduce the damage it inflicts, especially with early intervention. In what follows, we will explore what TNT has to say about this moderating effort.

Recall that the prime narrative's reason's main job is to provide expectations about the future so threats can be anticipated and action undertaken to mitigate them. This core evolutionary task requires constant vigilance and the implicit assumption that disaster lurks around every corner. In this sense, at least some degree of paranoia is humankind's natural state. The question is how to keep it within reasonable bounds while not unduly blunting one's ability to detect real threats.

In reference to threats, the article that got us thinking about all this (Riley, 2021) quotes a personal communication from Dr. Avshalom Caspi, a major figure in P-factor research: "If you look at every disorder, the core of every disorder is some sort of aberrant way of viewing or seeing the world"..."It's that paranoid ideation."..."One of the most interesting origins for much of this aberrant thought comes out of harsh and inconsistent and unpredictable early environments" ... "Those kinds of experiences that set up the anticipation of bad things happening, or they set up the anticipation of being rejected, they set up the anticipation of being violated, they set up anticipation of constantly being threatened, and things going wrong. Things, you know, being unalterable. And thereby spiraling out of control. So I think a lot of it is about what those early experiences do—they *distort our expectations about the future* [ital. ours]. And that's why they're so consequential." You can see the connection to TNT and why it captured our attention.

Dr. Caspi's comments describe two aspects of a malign environment; instability, in which the child doesn't know what is going to happen next and a stability in which the child knows and it isn't good. Instability makes the future unpredictable and therefore makes it difficult to detect threats or

[4] There are bright spots, however. Cognitive behavioral therapy, which we'll discuss below, seems effective in many cases, although less so for extremely severe, dissociative disorders.

initiate appropriate preventive action with any certainty. It also makes rule acquisition difficult because no rule works consistently. The result is constant anxiety and fear, not of specific threats so much as a general malaise, a feeling of helplessness resulting from lack of control over the future. Sometimes this results in retreat, hunkering down, defensiveness in an effort to endure what cannot be controlled. Other times it leads to action, but action often directed at things that can be controlled instead of the things than need to be controlled. Either way, the result is behavior that appears to others to be inappropriate—defensive or offensive—and, often, disproportionate to what they see as threatening.

Stability can be just as destructive if it consistently ends in pain. The child whose parent strikes out when drunk is not uncertain about the threat or his or her inability to do anything about it. Control is impossible, pain is inevitable, and the best to be hoped for is to moderate it a bit through hiding, propitiating actions, or the like—none of which is without its own risks.

So, vigilance, uncertainty, and inevitable harm, especially during early rule acquisition, are, perhaps, the seeds of later difficulties. The question is how they grow into thought dysfunction. It is here that TNT, while not unique in doing so, provides a possibly helpful way of looking at things.

But first, we have to resort to an age-old, but somewhat controversial, differentiation; psychosis vs neurosis (those two labels are anathema to many authorities, but we all know pretty much what they mean). We think that psychosis, aka dissociative disorders, probably are the result of underlying neurological anomalies—not necessarily the P-factor, but something that is wrong in the neurosystem. The usually cited evidence for this view is that if one identical twin is diagnosed as schizophrenic, in from 30% to 50% of the cases, the other twin will be similarly diagnosed. The rate is only 15% for fraternal twins, which is the same as for non-twin siblings. Presumably environmental factors are much the same for all siblings in a family, so the underlying issue is the genetic similarity between identical twins. This suggests that schizophrenia and similar disorders probably are best handled as neurological issues, although supportive therapy can help too.

Neurotic or functional disorders are something else again. Let us presume Dr. Caspi is correct and the development of at least some functional thought disorders starts with vigilance, uncertainty, and inevitable harm during childhood, just when many of one's most basic and enduring rules are being acquired. The result may well be that the rules that worked in those early dangerous situations cease to make sense in safe situations. They predict threats that don't happen and, as a result, prompt preventive actions that are inappropriate. It is the inappropriate expectation of bad things in

relatively benign situations and the resulting inappropriate action to prevent them from happening, which are the symptoms of disorder.

It's a vicious cycle. If you predict the future will be threatening and it is, if pain happens just as you expected, it means your predictive rules worked but your preventive rules didn't, increasing your certainty about the reliability of the former and reducing it for the latter. That is, your expectations for bad things are justified and you can't do anything to prevent them from happening. On the other hand, if the expected painful future doesn't happen, it doesn't prove that the rules that predicted it are wrong, it could mean your preventive actions worked. That is, your expectations for bad things are justified, but you sometimes can do something to prevent them from happening. It boils down to: Ignore the good stuff and keep on expecting the bad stuff. Keep on doing what your rules prescribe to fend off the bad stuff and sometimes it will work. Hunker down or strike out, but always expect pain.

Recall that thinking and communication use abridged, contextualized versions of the prime narrative, i.e., derived narratives. These are encoded in language and launched into the world in the form of what you say to yourself or things other people say to you. Once launched, they are events just as much as any of the other events that impinge on your senses. And, like any other events, they are incorporated into your prime narrative as something that has happened to you.

The role of derived narratives in functional thought disorders has long been recognized and is central to the most successful method of therapy available for such disorders. Called Cognitive Behavioral Therapy (CBT), it has many variants. But it is generally thought that they trace back to the 1950's and the work by a controversial psychologist, Albert Ellis. Dr. Ellis formulated a way of looking at behavior problems that focused heavily on how incorrect or inappropriate beliefs contributed to incorrect or inappropriate feelings and behavior and how those beliefs are reinforced by others' reactions to us but even more by the things we tell ourselves (see below). His arguments are detailed and too much to present here; suffice it to say, he was perhaps the first major figure to discuss how the things we tell ourselves influence our behavior. This is still an important aspect of CBT.

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Thomas (2016) lists Albert Ellis' 12 "lies we tell ourselves." Notice that most are rules for avoiding future threats, even when the threats are unspecified. That is, most of them include the word "must", which means

that they are standards that define how the world should be and imply that you will suffer severe negative consequences if it isn't.

1. I must have the love and approval of others. I must avoid disapproval at all costs.
2. I must be perfect and a success in all that I do. I must not make any mistakes.
3. People must always do the "right" thing. When they do not, they must be punished.
4. Things must be the way I want them to be, otherwise life will be intolerable.
5. My happiness (or unhappiness) is caused by external events. I have no control over my happiness (or unhappiness).
6. I must worry about things that are dangerous, unpleasant or frightening; otherwise they might actually happen.
7. I will be happier if I can avoid all of life's difficulties, unpleasantness or responsibilities.
8. I am weak and must depend on those who are stronger than I am.
9. Events in my past must strongly influence me, and they will continue to do so.
10. I must be upset when others have problems. I must be sad when others are unhappy.
11. I should not have to feel discomfort or pain. I must avoid feeling them at all cost.
12. There is one right and perfect solution to any problem

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CBT remedies are divided into cognitive techniques, behavioral techniques, and behavioral experiments. Cognitive techniques consist of "guided discovery", the key therapeutic tool of which is "Socratic questioning". The goal is to have the patient question the reasons (causes) and evidence (effects) for why they do what they do and to formulate alternatives. Essentially, the patients talk to themselves about the flaws in their rules, which is the opposite of the feedback loop that keeps the rules unchanged, even when they don't work.

Behavioral techniques include exercises in which a focus on the negative (threat) is combatted by focusing on the positive (nonthreat), planning each day in advance to avoid procrastination and to anticipate and be prepared for threatening situations. Essentially, this is Ellis' prescription to replace negative, destructive thoughts with more benign thoughts. This especially

applies to mood disorders. It is, perhaps, a prescription to avoid preoccupation with the news, which focuses on bad things and take more interest in the good things in one's life. Sounds a bit Pollyanna, but that doesn't make it wrong. After all, good things need not be saccharine, they just need to relieve preoccupation with tragedy.

Behavioral experiments are designed to help patients test their rules in an effort to understand how they use avoidance and escape to preclude having to test their anxiety-causing, threatening expectations ("If I leave the house, terrible things will happen, so I won't leave."). Anxiety also is treated with relaxation and breathing exercises.

The essence of these techniques is providing a safe place in which patients can explore the rules that drive their dysfunctional thinking and behavior, including moods. Socratic questioning reveals contradictions and errors in the prime and derived narratives, but that frequently is not enough to promote changes. So, cognitive techniques usually are augmented with things like focusing exercises to raise the threshold for what constitutes a threat and to restore positivity in the patient's repertory of words to encode derived narratives. Behavioral experiments provide empirical tests of the supposed catastrophic consequences of doing things or not doing them and demonstrate how avoidance and running away perpetuate dysfunctional solutions to problems that may not even exist or that aren't as threatening as believed.

From the TNT viewpoint, these CBT techniques make perfect sense, particularly behavioral experiments.[5] Putting things to an empirical test in a behavioral experiment is precisely what should be most effective; demonstrating that precipitating events may not cause the expected effect and/or the expected (threatening) event may not be as catastrophic as expected. Of course, just one discussion or one empirical test isn't going to completely change the prime narrative, but repetition should do so in the long haul.

So too, changing the patient's dysfunctional emotional standards turns on providing both alternative views and empirical experiences. This can be difficult because some of these emotional standards are supposedly the will of God, or a similar imperative, which means that the consequences of their violation is largely within the patient in the form of fear and guilt. But, in theory, the remedy is the same as for other fears, just more difficult to address.

The bottom line is the same here as we have seen previously: Replace destructive rules with better rules. But this is complicated (and potentially

[5] But this doesn't mean that other therapies are at odds with TNT, e.g., Korn (2021).

dangerous) when dysfunctional derived narratives are supplied by respected others—both traditional sources, such as family and friends, and newer sources, such as talk radio and the internet. If the goal is to correct fallacious assumptions and ill-founded fears and an authority persists in reinforcing those assumptions and fears, change will come slowly, if at all. This can happen, for example, if the patient's problem arises from paranoid thoughts revolving around assumed conspiracies and continues to devour such theories on the Web. We're reminded each day of the negative impact of such communications, especially in terms of extreme politics and religion.

Returning to the P-factor, we don't know what it is but we suspect it may be the experience of a dysfunctional environment that appears to be the common denominator for so many functional disorders. Especially in childhood, the dysfunction inevitably shapes the prime narrative which then consistently colors expectations, particularly about threat.[6] If so, its sets the conditions that are then expressed in behavior that, in its own way, follows rationally from the rules acquired to deal with those expected threats. As others have noted, there may be an internal logic to dysfunction even if other people can't figure it out (Sacks, 1985). We submit that this logic is the same logic that applies to "normal" behavior, it is just that the rules upon which the logic relies are distorted by the environment in which they were acquired.

Afterword

Just to be clear, it is important to distinguish between physical illness (Nord, 2021) and the kind of dysfunction described above. But, even at that, psychosis involves talking to yourself and saying things that are counterproductive. So a bit of what was said above is, perhaps, applicable.

Too, we aren't saying that all dysfunction is the result of telling yourself untruths, but a lot is. And your untruths aren't the only problem. Think about the previous essay on scams, conspiracies, and hoaxes; all based on untruths told by others and all resulting in dysfunctional behavior by the person who buys those untruths—i.e., behavior that is contrary to their own best interest and that outside observers would judge to be folly, if not madness.

[6] Of course, dysfunctional environments aren't limited to childhood. Traumatic events in later life can have similar effects, e.g., post-traumatic stress disorder, PTSD.

Essay #16:
Imagination, Sympathy, and Empathy

Imagination plays an important role in TNT, but not quite the way it is usually thought of. True, when you imagine the future, it often is a lot like a movie with you as its audience; like "theatre of the mind". But, TNT has no mind or anything like it; things happen by causal necessity. So, what does TNT make of imagination?

First, a more basic question: "What makes imagination possible?" To answer this, recall from Essay #1 that the brain is a synthesizer: Perception is the brain synthesizing events from sensations, memory is the brain synthesizing episodes from events, and structuring is the brain synthesizing narratives from events and episodes. But, fundamental as they are, events and episodes are not the smallest elements, the basic building blocks. Rather, they are themselves constructed of "sensory images".[1] The latter are the residuals, the lasting traces, of the visual, auditory, kinesthetic, olfactory, etc. sensations that occurred as a result of changes in sensory input that reflect changes in your internal and external environments (habitat). When the brain synthesizes events, episodes, and narrative, it is these lasting sensory images, not the fleeting sensations themselves, which are being synthesized.

The differentiation between brief sensations and lingering sensory images is important because it may be what makes imagination possible.

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[1] Which, perhaps, are themselves composites of smaller and more abstract entities. For example, if we think of sensory activity as a continuous wave of sensory activity, composed of multiple component waves, it is possible to summarize the essence of the complex wave in terms of essential points, called *pixels* (Smith, 2021). Indeed, the complex wave can be reconstructed from its pixels. If we assume that the complex wave equates with ongoing sensory experience, it follows that the experience can be summarized and stored as pixels to be resynthesized when necessary—so called constructive memory. If this makes any sort of sense, we can think of sensory images as pixel-based reconstructions of previous sensory stimulation, making pixels the fundamental element. This is a new idea for us; clearly we haven't thought it through as thoroughly as we must. But it is intriguing, if only because it suggests that the basic elements of cognition are ("pixelized") digital summaries of continuous experiential waves.

But, we're getting ahead of ourselves. First, let's take a look at what is generally known about imagination.

What's Known

Imagination is less understood than one might expect. Like memory, researchers have divided it into various functional categories; some researchers say eight categories but others claim either more or fewer. However many there are, the categories tell you more about where imagination comes into play than what it is. Other than that, a bit of reading and a bit of introspection suggests the following:

1. About 1% of the population congenitally lacks visual imagery, which is what usually is thought of when we think of imagination. Those who lack it also evidence reduced imagery in their other senses, a condition known as *aphantasia* (Zeman, Dewar & Della Sala, 2015). The condition was first described by Sir Francis Galton (1880), but it has only recently been given a name and studied extensively. People who lack imagery often are unaware of it, although they often feel that they are somehow different from others. Research also shows that aphantiasics have less vivid memories of events in their pasts, and fewer and impoverished dreams (Dawes, Keogh, Andrillon, et al., 2020). They have no apparent impairment of their other cognitive faculties and the fact that many of them are successful in creative endeavors that normally are associated with visual imagination, suggests that they tend to develop other cognitive skills to compensate.
2. What people imagine is, in fact, composed of events from their past experience—maybe not precisely the same, but basically the same (e.g., Byrne, 2005). Ultimately, everything comes back to the sensory images that are synthesized into events and episodes that end up as records of the past. These images provide the elements for imagination, which is why it is difficult, maybe impossible, to imagine anything with elements that are substantially different from what you've experienced—the elements may end up in unique patterns (sometimes creative, sometimes bizarre, sometimes both), but they are essentially recognizable. Indeed, no matter what imagination produces, the fact that you can make some kind of sense of it suggests its elements are not so exceptional that they transcend your previous experience.

3. Tethering imagination to the familiar may disappoint those who like to think of it as magical, producing penetrating new insights and glimpses of worlds beyond conventional experience. The thrill of an insight may suggest it is something special, but as was just said, it has to be within the range of more prosaic experience or you wouldn't understand it, so you couldn't know if it was insightful or not. And, glimpses beyond your conventional experience would have the same problem; they wouldn't make sense so it would be difficult to know, let alone prove, that they are actually glimpses of anything special.[2] Their arrangement, the tales they tell, may be novel, but the elements that make up that story are not wholly unfamiliar.
4. Extending that last point, when we observe our own imaginings, we see that the tales they tell are indeed a mix of familiar events—but often altered in interesting ways. Even so, they aren't a hodgepodge; they are ordered compositions of events that convey something different, but not very different, from what those same events otherwise would have conveyed. Events in this mix seem less detailed, less substantial than the originals; even less substantial than recollections of them. That is, they are familiar, but they are not precise copies of the originals or even memories of the originals. They are something like paraphrases or gists. Perhaps it is this lack of detail that allows imagination to work so quickly, far faster than the time it would take to experience the real events.
5. Short of a drug experience or a psychosis, people seldom confuse what they imagine with actual experience. In this sense, what is imagined resembles fiction and art in that it can be very compelling, evoking strong emotions, but it isn't the same as the real thing. Interestingly, even very young children can differentiate imaginings and reality, which is what allows them to grow out of believing that The Cat in the Hat and the cartoons on TV might be real (e.g., Estes,

[2] You might think that, for example, discoveries in quantum physics and astrophysics, which lie far outside any human's sensory experience, provide evidence against this statement. But, physics is fundamentally mathematics and its more exotic discoveries are implied by the math rather than the result of direct experience. Thus, they can be far removed from anyone's experience, even the physicists' and still be logically plausible. In his review of what mathematics did to physics, Gingras (2001) observed, "(B)y its ever greater abstract of treatment of phenomena, mathematization led to the vanishing of substances (p. 385). This is reflected in physicists' attempts to relate their abstract concepts to everyday experience, which seldom work very well, relying on analogy and metaphor rather than actual experience.

Wellman, & Wooley, 1989). [It also is what allows them to lie and to detect when others are lying to them (Pinto & Gamannossi, 2014).]

6. Finally, there is a growing body of research examining the parts of the brain involved in imagination and the parts involved in the experience of real events. Not surprisingly, they turn out to be much the same (e.g., Mullally & Maguire, 2013; O'Craven & Kanwisher, 2000). But, it appears that the parts of the brain that are used for imagining the future and are different from those used for evaluating the desirability of that future (Lee, Parthasarathi, & Kabe, 2021).

Imagination in TNT

In TNT, imagination simply is the brain doing its job of synthesizing sensory images into coherent bundles:

- Synthesizing retained past sensory images to create memories, which seldom are exactly what happened and often incorporate information that occurred after the recalled events if doing so makes a more coherent derived narrative about the past.
- Synthesizing the ongoing sequence of perceived events into episodes that give the impression that the present is more than a brief, transient, moment; giving it extension and substance.
- Synthesizing the causal implications of events and episodes to create an expected future.

All of which is how we've discussed synthesis in previous essays. But, the brain is a restless organ, it doesn't necessarily stop when its job is done. So, it keeps tinkering, if you will, with all the retained sensory images, resynthesizing them into alternative configurations. This isn't idle busywork, it is the brain constantly refreshing the content of the prime narrative; anything that increases coherence is retained and all the rest, all the combinations and variations, are tagged as transient and imaginary.

Empathy and Sympathy

Sympathy and empathy are special cases of imagination. Sympathy is an imagined narrative about another person's or animal's circumstances—what led to their plight, what the plight is, and what will follow as a result. Its elements derived from the event/episode history in your prime narrative—either what has actually happened to you or what you've learned

from novels, stories you're told, or TV and movies. Sympathy allows you to say that you understand the other's problem.

Empathy is an equally imaginary narrative about the other's emotions. It allows you to say that you understand the other's emotional reaction to their problem. But, of course, you know full well that you can't really understand others' emotions, you can only assume that they feel as you imagine you would feel if you were in their shoes. That is, how you would feel if faced with their problem, drawing upon your own past experience, how you felt when faced with similar problems.

So, when you encounter a fellow creature in distress, you experience a sympathetic impulse, which draws upon your own experience in similar circumstances to, in effect, diagnose the problem. As the sympathetic narrative forms, a parallel empathetic narrative forms. The latter is what motivates you to continue involvement rather than simply walking away.[3]

We usually think of sympathy and empathy in terms of individuals in a moment of difficulty; a threat in progress. But, they both apply as well to groups of people in difficulty. And, hard as it is to understand the plight of someone you know well, it is even more difficult to understand the plight of strangers, especially when their lives are markedly different from yours. This is a problem everywhere, but, for the United States, it approaches being an existential threat.

At issue is the American promise of equality and social justice and the seeming inability, or unwillingness, to extend it to everyone. Because we don't want to focus on any particular group, we'll use the terms "powerful" and "powerless" for different groups of people who share a physical space (e.g., a country) but do not experience it in the same way and who have unequal opportunity to influence what they experience and how they experience it. Of interest is the gap in understanding produced by this difference in power and experience.

Usually, the consequences of this gap falls hardest upon the least powerful. And, because they lack power, they must attempt to create enough sympathy and empathy to move the powerful to take mitigating action on their behalf—which is an uphill battle because it requires the powerful to shift at least some of their power to the powerless. Moreover, being the supplicant seldom sits well with the powerless, and sometimes they resort to violence in an attempt to increase their power through threat. But, violence invites retaliation and suppression by the powerful, so, ultimately, the powerless must convince rather than intimidate or the gap gets even

[3] People who lack the empathetic impulse are called psychopaths. This doesn't mean they're serial killers, it means they are relatively incapable of understanding and responding to others' emotions.

wider. And moving the powerful to take desirable action, rather than action that increases the power disparity, requires the fostering of accurate sympathy and empathy. Accurate because the powerful's actions have to be directed at the things that are important to the powerless or they are wasted.

Unless blinkered by malice, intentional ignorance, or fear, the powerful usually are capable of sympathy; empathy is the problem. For example, the Black Lives Matter movement and the trials of police accused of murder have made the social justice part of the problem clear to everyone who is willing to look. The result is an outpouring of White Liberal sympathy, which is great, as far as it goes. But, it appears to us that the powerful are generally ill-prepared to empathize with the powerless. Few among the powerful have had experienced anything like the experiences of the powerless. As a consequence, they simply cannot imagine what it is to be powerless, to have the system work against you instead of for you, to spend every moment mobilized against encroachment by those more powerful than you. Lacking these essential insights, it isn't clear how the powerful should constructively exercise their power for mitigation, what the priorities should be, and what meaningful mitigation would look like.

This empathetic barrier reflects inability, not just unwillingness.[4] Without the relevant experience, the empathetic narratives of the powerful are too bland, too hopeful, too lacking in urgency. And thus they fail to prompt the bold action needed for change.[5] As a result, nothing much is done; minor tinkering with the broken system until the emphatic impulse is exhausted. And, if this failure prompts protest from the powerless, it is branded as ingratitude and a "law and order" issue that justifies calling out the police. Rarely, there is real reform. But even when there is, it seldom is the massive overhaul that democracy and social justice demand.

We don't know the solution to this problem. We do know that the belief by the powerful that they understand the powerless' problems and how they feel about them is often viewed as presumptuous by the powerless. And rightly so. But, change has to begin somewhere. Perhaps it has begun with the recent intense focus on information about the threats the powerless face, aligning sympathy more accurately with how the powerless view those threats. If so, the effort must continue with education of empathy so there is

[4] We suspect that this is what underlies "unconscious racism", ignorance rather than malice—or, at least, not malice alone. At its core is long-accepted norms and standards that reflect their racist roots and are so familiar that their effects go unrecognized—except by the people on the receiving end. This, of course, is what Critical Race Theory is all about.

[5] Making Juneteenth a national holiday is nice, even helpful, but it really doesn't replace effective legislation and police reform.

a more accurate understanding of how the powerless feel about those problems. Imposition of solutions based on sympathy alone is likely to result in more fruitless tinkering; good solutions allow for and are guided by the values, preferences, and feelings of the people who are impacted.

Afterword

We have to apologize for the political turn this essay took. But, the point of all the essays in this part of the book is to examine implications and applications of TNT, and what could be more real-world than power inequity? Anyway, the point is that imagination is neither just a movie in your head nor a source of magical insights. It is a useful, work-a-day, manifestation of how the brain works as it bundles events into coherent narratives. It is manifested in sympathy—understanding another being's plight—and empathy—understanding how they feel about it.

Essay # 17:
The Self

Throughout these essays, we have referred to "you" creating narratives, "you" evaluating the desirability of the future, "you" taking action to change the future, and so on. But, this conventional and convenient use of the pronoun risks wrongly implying that the "you" (or, from your viewpoint, "I") doing all of this is substantively different from everything else we have been discussing; some sort of mysterious, high-level instigator of thought and action resembling the traditional concept of an executive mind. But if not that, what? In this essay we will address this, the question of "I".[1]

"I"

Consider the most basic manifestation of "I," one that humans share with other animals. This is "I" as an entity that is to some degree separate from the physical environment. It is rooted in the ability to differentiate "I" from "other," however ill-defined and fuzzy that differentiation may be. But, even a modicum of differentiation implies self-awareness, although not necessarily the acute self-awareness with which we are all familiar. In addition to differentiation, advantageous manipulation of "other" requires appraisal of the relationship between "I" and "other".

Self-awareness

Self-awareness results from the operation of specific subsystems in the brain. To one degree or other, it is common to a wide variety of animals. But primates, and particularly humans, have evolved beyond the formative "I" to a more elaborated "I", with the human "I" being distinctly more singular and more malleable than that of any other species.

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[1] This essay is adapted from Beach, Bissell, & Wise (2016). Note the similarities between what we are saying here and the viewpoint known as narrative self in personality and social psychology (e.g., McAdams, 2001; McLean, Pasupathi, & Pals, 2007).

Humans' exteroceptory perceptual systems—visual, auditory, haptic, olfactory, gustatory—have evolved to differentiate between the individual and his or her external environment as well as distinguishing among the entities in the environment. Kinesthetic perceptual systems—proprioception (muscles and joints) and your vestibular system—have evolved to treat the "I" part of this differentiation as a unit by sensing the location of the various body parts relative to the body's core as well as sensing the body's movement in space and its orientation relative to gravity. Introceptory perceptual systems—pain, hunger, internal organs—also treat "I" as a unit, sensing what is going on inside the body (Monti, 2021). In short, although all of these perceptual systems enhance the differentiation between "I" and "other", some focus externally and others, presuming a unitary body, focus inwardly. Together, they establish the foundation for self-awareness.

We are not neurologists, so what follows is our best interpretation of what we have learned about the neurology of self-awareness. The first thing is that it is difficult to study self-awareness in animals other than humans, largely because verbal report is a major component of the research methodology. The second thing is that much of what is known comes from observing which parts of the brain evidence activity (both electrical and increased blood flow) when the person being studied is shown a picture or a word or is asked to imagine something. Increased activity at a specific site is taken to mean the site is normally involved in the specific aspect of self-awareness that is under investigation, and the, often unstated, assumption is that the activity is essential to, not merely correlated with, self-awareness.

The results of these studies suggest that the combined activities of specific sites in the cortex (the medial prefrontal cortex, the posterior parietal cortex, the anterior and posterior cingulate cortex, and the insular cortex), result in self-awareness, in that they are active when the study participants engage in self-referenced thought. The perception of one's body as part of one's self also involves specific sections of the cortex (the temporoparietal junction is involved in sensory integration and the extrastriate body in the lateral occipitotemporal cortex is involved in thoughts about parts of the body). The latter, perceiving one's body as an integrated whole, is particularly important because it reveals a differentiation between body and non-body, which is critical for defining the boundaries of the physical self. Finally, there are sections of the cortex that appear to specialize in autobiographical memory (the left dorsolateral prefrontal cortex and the posterior cingulate cortex), which is essential for a sense of self-continuity over time.

Emotion

But, self-awareness is not enough. It differentiates the individual from "other," but survival requires more. Specifically, it requires an appraisal of the threat or the opportunity presented by "other"—by surrounding people, objects, and occurrences—as well as an appraisal of whether action is required. This appraisal/motivation mechanism is called emotion.

Using methods much like those used for studying self-awareness, research points to two subsystems of the brain being involved in emotion. One subsystem (parts of the pre-frontal cortex and cingulate cortex) determines the degree of pleasantness or unpleasantness associated with the emotional event, called emotional *valence*, and the other subsystem (parts of the parahippocampus, the cingulate cortex and prefrontal cortex, and the cerebellum) determines the degree to which the event triggers action, called emotional *arousal*. (For humans, the specific name attached to the emotion depends upon the context.)

Together, self-awareness and emotion (valence and arousal) are sufficient for a formative "I". Moreover, the brain's ability to combine self-awareness and emotion into a formative "I" applies to animals other than ourselves. Anyone who owns a dog knows that it has a basic sense of self and it certainly is clear that it has emotions. Were your dog able to speak, it might not be able to describe its life since it was a puppy or even tell you much about what happened last week. But, it clearly can differentiate between itself and its surrounding environment—between itself and a fire plug, itself and other dogs, itself and you—and can evaluate the desirability of each as well as the need to do something about it. This is evidenced by its ability to manipulate its environment to solve problems (carrying an empty food bowl to you without having been trained to do so), to engage in social behavior (play and other interactions with you and other dogs—sometimes hostilely and sometimes not), and its ability to recognize you and express emotion when you have been gone and are now returned. And, what appears to be true for dogs is likely true to one degree or another for other animals as well. While acknowledging that there is a range of self-awareness among animals, let us refer to everything up to and including primate self-awareness as basic self-awareness, the formative "I".

The Elaborated "I"

Humans have two things that other animals don't have that affords a more elaborated sense of self than the formative "I". These are elaborated language and elaborated derived narratives. That is to say, although other

animals have a prime narrative (at least rudimentary understanding of what is going on and, perhaps, why) as well as some sort of communications, both are fairly simple when compared with humans'. Most, if not all, animals must have some form of prime narrative that ties their memory to what is happening now and to their anticipated future or they couldn't learn or appropriately use anything they could learn. And many animals communicate with each other through various sounds and actions. That said, their formative "I" lacks the elaboration of even a fairly young human who has acquired the rudiments of language and a modest store of experience

Language

The richness of derived narratives stems from their being encoded in language. Language of any complexity is uniquely human and it plays a correspondingly unique role in human self-awareness. Indeed, non-vocalized language—called inner speech (Alderson-Day & Fernyhough, 2015)—as well as talking aloud to yourself (Ariel, 2021; Athens, 1994), is both a tool for thinking and essential for anything much more than the basic self-awareness we share with other animals. Evidence for the latter was reviewed by the Canadian psychologist Dr. Alain Morin (2001), including a description of a man who lost his ability to use language due to a stroke but later regained it. He later stated that when he was unable to use language, "I … lost the ability … to engage in self-talk. In other words, I did not have the ability to think about the future—to worry, to anticipate or perceive it—at least not with words. Thus for the first four or five weeks after hospitalization *I simply existed"* (emphasis is in the original text).

On the basis of this description, and the fact that inner speech and self-awareness share the left inferior frontal gyrus, Dr. Morin proposed that inner speech is the main cognitive process leading to self-awareness. "That is, self-talk allows us to verbally identify and process information about our current...experiences … At an even higher level, I suggest that our internal dialogue is also what makes us aware of our own existence … Being [aware] that you exist is *not* the same as "simply existing."" Moreover, Dr. Morin cites evidence that the more one engages in inner speech, the more self-aware one becomes. And, as the example of the stroke victim demonstrates, the loss of inner speech decreases self-awareness and recovery of inner speech restores it.

Dr. Morin further observes that "Inner speech makes it possible to communicate and develop a relationship *with ourselves*. We can talk to ourselves as if we were speaking to someone else; in this process we can produce for ourselves appraisals similar to those we get from others. For

example, we can say to ourselves, "You're very strong, emotional, lazy, etc. …" Talking to ourselves that way most certainly makes us self-aware …"

In our terms, inner speech aids in the elaboration of the formative "I", which is simple self-awareness, into what is generally referred to as self-concept.

Narrative

The second factor contributing to human's ability to elaborate self-awareness is the ubiquitous presence of "I" in every experience and every story one tells about that experience, even the stories that merely recount a story told by someone else (e.g., Kanagawa, Cross & Markus, 2001). That is, your version of what you were told includes you as the listener, which makes you a participant in the narrative. By the same token, when you read a book, the narrative is the author's, but your version of it necessarily includes you as the reader and, thus, as a participant. You do not possess a single narrative, prime or derived, that does not include you as a featured actor, a supporting actor, or observer. We'll call this ubiquitous actor your *narrative self*. It has two components, a *ubiquitous self* and a *causal self*.

Because you are an element of every one of your narratives, both your prime narrative and every derived narrative, those aspects of you which are constant across them define your ubiquitous self. On the other hand, your causal self depends upon the fact that narratives are largely about what causes what. Recall that for the narrative to be coherent, all of the events in it must have causes. This requirement is easily met when causation can clearly be attributed to other, to external entities. However, when there is no obvious external causal entity, coherence requires the void to be filled. And it is filled through a process of elimination: No external element of the narrative was causal, so only two possibilities remain, "I" and some version of Providence (God, luck, angels, etc.).

If the narrative supplies adequate means and motive for its "I" element to have been causal, "I" fills the void and you conclude that your actions were the cause of whatever was previously causeless. If inadequate means and motive are supplied, God, luck, angles, etc. fills the void. Note that attributing causation to the "I" element in the narrative elevates it from actor/observer to instigator/shaper.

The Constructed "I"

The elaborated "I" has the formative "I" as its foundation and is constructed by inner speech and the narrative self—both the ubiquitous self

and the instigating/shaping/causal self. But, being a construction does not make it less real or less essential. Many constructions are quite real and fundamental to your conscious experience, as well as to your survival. What you experience as sound, for example, does not exist in the physical world. Sound is your brain's synthesis of the waves of molecular motion that result from vibration. Yet, the blasting whistle of an oncoming train is no less compelling for being a construction. Neither does color exist in the physical world. It is your brain's synthesis of the varying wavelengths of reflected light. Yet, the colored stripes on a venomous snake are no less alarming for being constructed. The three-dimensional depth of the physical world is real enough, but you do not sense it directly. Visual depth is your brain's synthesis of the discrepant two-dimensional images on the retinas of your two eyes. Yet, you never doubt the veridicality of your depth perception when you pull your car into rush hour traffic. And so on. The world that seems so straightforward and familiar is, in fact, constructed by your synthesizing brain.

So, the constructed/synthesized nature of the perceived self is in keeping with the rest of your perceptual experience (Fleming, 2021). And, like those other constructions, the perceived self, the "I," is essential. It differentiates between you and the people, objects, and what is occurring around you. It is the focal point for all self-reference, especially when you are communicating with others. And, as a narrative element, it serves as a marker or proxy for a store of unsaid but acknowledged information about you, the use of which simplifies narratives without impoverishing them. In short, like the prime narrative and the other constructions/syntheses we've discussed throughout this book, the self, "I", exists because it is useful.

Afterword

The relevance of all of this for TNT is to make clear that the absence of executive mind in the theory does not mean the theory says that "I" doesn't exist. It just means that when you're thinking scientifically about cognition, specifically about TNT, you can't rely on "I" or anything like it as an explanatory concept. "I" is a result of thought, not the active instigator or director of it.

Of course, when you're off duty and not thinking scientifically, you're free to use "I" like everyone else does—not doing so would make communication very cumbersome and confuse other people no end. Indeed, part of why we all get caught up in "I" as agency/executive is that encoding derived narratives in language often requires it. Other than the passive voice, in which things just happen and the cause is either assumed or goes

unspecified, sentences require an agent. And, as soon as I, me, my, we, us, our, or you creeps into a derived narrative, it is only a hop and a skip to giving it agency and putting it in the driver's seat. It simply is embedded in the language.

On the other hand, denying "I" has agency doesn't mean it is simply an illusion. "I' is as real as anything else—tables, chairs, other people, and all the rest. Like them, it is construction, a product of your brain's ability to synthesize. In this case, the synthetization is of your presence at everything you experience and the result is a sense of self, of "I'—it just doesn't have the agency that usually is attributed to it. It is not something special in your head that directs your life.

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