**Content and Control in Naturalistic Decision Making**

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**Abstract**

 The handful of theories that make up the naturalistic decision canon are designed to account for macro-level problem-solving decisions, usually job-related. Although some of these theories have been in use for over 30 years, little effort has been made to expand their reach by linking them to broader, more basic, psychological concepts. Two potential links are content and action. Content refers to decision makers’ narratives about the problem they face and what can be expected to happen if nothing is done to solve it. Action refers to their narratives about what to do when doing nothing is unacceptable. A control model for decisions about ‘what will happen’ and about ‘what to do’ is presented and the implications are discussed.

 Early research on decision making was rooted in the assumption that, to one degree or other, all decisions are risky and, therefore, are essentially bets (e.g., Luce & Raiffa, 1957). This led to the not unreasonable conclusion that the mathematics developed to evaluate risky commercial decisions or decisions about how to prevail in games of chance provides prescriptive (*normative*) models for how decisions should be made and, therefore, are appropriate criteria for studying the adequacy of those decisions. As a result, research focused upon how closely research participants’ decisions[[1]](#footnote-1) resembled the decisions a logician, statistician, or similar professional would prescribe using the applicable tools of their disciplines.

 At first, results seemed encouraging (Peterson & Beach, 1967). But, they soon were swamped by studies which found the resemblance between ordinary peoples’ decisions and normative prescriptions to be slight or nonexistent (Hershey & Shoemaker, 1980).[[2]](#footnote-2) It quickly became settled opinion that people’s decision processes are unlike the normative prescriptions and, as a consequence, the decisions people make are seriously flawed.

 This ‘normative’ line of research culminated in Kahneman’s (2011) two-system theory, which posits two modes of thought, System 1 and System 2. System 1 is for everyday, rapid, decisions—the sort that result in differences between research participants’ decisions and normative prescriptions. System 2 is for carefully considered, analytic, decisions—among which are decisions that correspond to normative prescriptions. Absent a working knowledge of probability theory, sampling theory, economic decision theory, formal logic, and so on, System 2 is unavailable to most people. So, most decisions are the product of System 1, which boils down to the use of rules-of-thumb, called heuristics, and the errors they produce, called biases identified earlier by Tversky and Kahneman (1974).

 Over the years, a profusion of studies has identified biases in a wide variety of circumstances, and they keep coming. But it is not clear how all of them result from application of the heuristics or how they relate to each other. To the world in general, the message simply seems to be that people do not make very good decisions and they tend to be biased. Most people already knew this, but now they have data.

 As all of this was taking place, a very different story was being told by researchers who observed everyday, on-the-job decision making. They concluded that ‘real world’ decision makers are not necessarily bad at it, they simply are not trying to do the same thing the normative models are designed to do. They are less concerned about making the right decision, in a normative sense, than about figuring out what needs to be done and embarking upon a course of action that is flexible enough to drive through to success. This makes the normative models questionable as either prescriptions for what decision makers should do or as criteria for evaluating what they actually do (e.g., Isenberg, 1984; Mintzberg, 1975; Peters, 1979).

 These observations suggested that when making decisions about things they know and care about, decision makers are not as hopeless as the normative research portrayed them to be. This view prompted a countermovement, called *naturalistic* decision research, that focused on how decisions furthered the interests of the decision maker rather than on whether they conformed to normative prescriptions (Lipshitz, et al. 2001). The foundational work was recognition-based theory (Klein, 1993, 1998) in which the decision is about which solution is appropriate to a recognized problem; reason-based theories (Jungermann & Thuring, 1987; Lipshitz, 1993; Pennington & Hastie, 1988, 1992) in which decision makers gather information, construct a plausible account about what is going on and make decisions that are congruent with the account; incrementalist theories (Braybrooke & Lindblom, 1963; Connolly, 1988; Connolly and Wagner, 1988; Lindbloom, 1963) in which decisions are about steps toward a better state of affairs (or, at least, away from a bad one); moral/ethical theory (Etzioni, 1988, 1993) in which decisions are dictated by enduring morals and culturally shared values; and agenda-based theory (Beach & Mitchell, 1990; Dunnegan, 1995) in which decisions are about what goals to pursue, how to pursue them, and how well pursuit is succeeding as it is executed. Although these theories date to the 1980’s and 90’s, they, and more recent versions of them, continue to have influence (e.g., Falzer, 2018; Gore, Banks, & Kyriakidu, 2006; Rutten, et. al, 2013).

 My reading of these theories suggests two things: First, most naturalistic theories presume that the decision maker knows what is happening and why. He or she also knows whether what is happening is good or bad and, if it is bad, what will happen if nothing is done to fix it. Finally, he or she either knows how to fix it or knows how to find out how to fix it. This knowledge is the content about which decisions are made. And, notice how it is organized: what has gone wrong (the present), what caused it to go wrong (the past), what will happen if it is not fixed (the future), and what can be done to fix it (action). This form of knowledge-organization is called *narrative*: a temporal-causal story about the past, which caused the present, which will cause the future, including what can be done to cause the future to be better than it will be if nothing is done. If my reading is correct, if the content for decision making is organized as a narrative, it seems likely that a broader understanding of narrative can contribute to a better understanding of decisions and actions.

 The second thing suggested by my reading of these theories is that most of them, implicitly, are control systems (Beach, 2018). What has gone wrong is the sensed state of the ‘system’, what would be right is the reference state, and what should be done is the control variable. Decisions are about whether and how to exert control to bring the sensed state to within acceptable limits of the reference state. For control systems, as with narrative content, time and causation are fundamental. The unsatisfactory present is immutable and was caused by events in the indelible past. Control (action) must focus on the future, manipulating relevant parts of the physical and social environments to prevent the problem from persisting and ensuring a more satisfactory future.

 Naturalistic theories are about macro-level, observed behavior, which is reflected in a wide range of real world research (Gore, Banks, & Kyriakidou, 2006; Gore, Ward, & Conway et al, 2018). There have been attempts to ground the theories in micro-level processes, but the distance between macro and micro is vast (Schraagen, Militello, Ormerod, & Lipshitz, 2008). Someday it may be possible to explain the action of a firefighter in terms of neuroprocesses, but trying to do so now requires undue speculation. It might be wiser to tie the theories to a suitable meso-level intermediary which has a reasonable chance of establishing ties to micro-level processes. In what follows, I will present such an intermediary; tied to naturalistic theories through content and control and providing a meso-level platform for further theoretical development, new research directions, and, as things progress, the sought-for ties to micro-level processes (e.g., Mar, 2004).

**Conten**t[[3]](#footnote-3)

 A 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 happened and what caused them to happen (Atkinson, 1978).[[4]](#footnote-4)

**Time and Causality**

 Philosophers may not be sure that time is real (e. g., McTaggart, 1908; Thomas, 2020) and physicists may not be sure the world is deterministic (e. g., Musser, 2017), but humans and other creatures behave as though both are true (Cheng, 1997; Holyoak & Cheng, 2011; Lagnado & Solman, 2016; Sobel & Kirkham, 2006; Solman & Lagnado, 2015). We operate as though everything that happens has been caused by something that happened previously and will be the cause of something that happens subsequently.[[5]](#footnote-5)

 There are two mutually non-competing ways of characterizing narrative structure. One is literal, which describes narrative in terms of constituent events and their temporal/causal links. In this characterization, causal links between events have direction and strength. Direction means that occurrence of an event influences the occurrence of subsequent events (X→Y), which reflects the links’ temporal nature. Strength is how directly that influence is exerted. That is, causal links are not necessarily direct (e.g., X→G→K→ ... →Y), but the more direct they are the stronger they are. Basically, the literal characterization of a narrative is simply a temporal list of causally linked events, as might be captured in a diagram or inventory.

 The other characterization is figurative, which describes the narrative in terms of its broader meaning; its gist, storyline, or narrative flow. This characterization is supported by a long history of research, from the famous studies by Bartlett (1932) to recent research by Raynal, Clemet, & Sander (2020), demonstrating that figurative structure is more important than literal structure in retrieval of relevant information from memory, which, of course, is what enriches current experience and gives it depth. It is the figurative that makes a narrative more than just a temporal list of causally linked events and gives it meaning.

 The literal and figurative are not competing because they are two aspects of the same thing. There would be no figurative without the literal structure, which would lack depth of meaning without the figurative.

**The Implied Future**

It is easy to understand narratives as reflections of past and present experience, because the events in them have happened or are happening. It is more difficult to understand them in regard to the future, because the future has yet to happen. It is here that time and causality are key because they provide predictability. If, in the past you have experienced or been taught that X causes Y, then, if X is occurring now, the future occurrence of Y is implied. At the moment that X is occurring, Y is merely a causal implication because it has not yet happened, but, depending upon the strength (directness) of the causal link between X and Y, it is the best prediction of the future—the best extension of the narrative’s storyline. Note that the strength of the causal link is a measure of the reliability of the predictive rule and its implication—this will become important, below, when decision making is discussed.

**Predicting Threat**

The ability to predict the future may well have evolved to support survival. Predicting potential threats before they happen provides the opportunity to prevent them or soften the blow. Of course, not all threats are so grave that they jeopardize survival; expectations of pain or discomfort may be sufficient to warrant action. They do not even have to be physical; anticipated aggravation and hassle, potential loss of esteem, or the possible failure of opportunities to materialize or benefits to be realized are all threats that require mitigation. But, whatever their gravity, the most efficient way to handle threats is to anticipate them and deal with them before they cause damage.

**Language and Prediction**

 The superior ability of humans to predict the future, especially the extended future, is due in large part to our ability to use language to communicate with ourselves and with others. By the time we are able to speak in coherent sentences, our narratives contain a rich causal network involving a large number of events in the past and present and predicting a large number of events in the immediate and extended future. Subjectively, this is experienced as understanding what is going on. But this understanding is far richer and more complex than is either essential or convenient for communication, which requires a simpler, more straightforward story. Consequently, subjective experience is abridged for communicating with ourselves in the form of subvocal thought or with others in the form of vocalized or written statements. Abridgment usually keeps to the gist, the strongest causal links in the narrative, relegating everything else to the background.

 Abridgements for communication are called *derived* narratives, and there are two kinds (Beach, 2010; Bruner, 1990). The first, called *chronicle* *narratives*, are what we tell ourselves and others about what is going on, including the future. The second, called *procedural* *narratives*, are about how to do things and what the result will be. The latter are plans of action, recipes, for producing changes in the environment that will change the future from what currently is expected to happen into something else, hopefully something more favorable. In short, the two kinds of narratives are about ‘knowing that’ and ‘knowing how’ (Ryle, 1945).[[6]](#footnote-6)

**Control**

 Let us review: A control system has three variables, the sensed state, the reference state, and the control variable. The control variable, action, is triggered when the discrepancy between the sensed and reference states exceeds some acceptable limit. When applied to naturalistic decision making, the sensed state is what is wrong, the reference state is the decision maker’s standards for how things should be instead. When the discrepancy between the two exceeds some acceptable minimum, corrective action is taken.

**Standards**

 As the move from childhood to maturity, people learn standards for how the world should work, including how they and others should behave. Some of these standards were acquired through experience and some through instruction. Either way, they are about security, enduring values and beliefs, and transient preferences. Security includes physical and mental well-being, acceptance, affection, social ties, and so on. Values and beliefs include morals, ethics, and ideals—equity, justice, solidarity, stewardship, truth, beauty, and goodness—together with civic and religious ideologies and the responsibilities one ideally should assume in the course of performing one’s daily duties and engaging in social interactions (eg., Statler & Oliver, 2016). Preferences include wants and partialities and may vary over time and circumstance.

**Emotions**

 At the same time that they are acquiring standards, they also were learning how negative it feels when they are violated. Violations are discrepancies between how things are or will be (the sensed state) and how they should be (the reference state), the greater the discrepancy, the more intense the negative emotion. Violations resulting from exceeding standards can be as intensely negative as violations resulting from falling short of standards.[[7]](#footnote-7) When violations evoke significantly intense negative emotion, the discrepant events constitute *threats* and the intensity of the emotion is, called *threat* *intensity*.[[8]](#footnote-8) In short, discrepancies are subjectively experienced as negative emotional reactions to threats to one’s standards. (In the work upon which this account is based, the importance of emotions is explored more thoroughly, but that degree of detail is not necessary for the present purpose. In what follows, the focus will be on degree of discrepancy and the reader is invited to think of it as degree of emotional intensity.)

**Decisions**

 There are two kinds of decisions and they are made successively. The first is a yes-no decision about whether the threat intensity of the expected future is unacceptably threatening. The second is a choice of a course of corrective action when the first decision is ‘yes’.

 Decisions about expected future threat begin with the assumption that, within tolerable limits, it is unthreatening. This assumption is retained until evidence proves otherwise. Evidence is the overall intensity of the expected future threat, *Te*.; the larger it is, the more threatening the future is expected to be. At some point *Te* becomes too large to sustain the assumption of a benign future, prompting search for a corrective action (Beach, 2009).[[9]](#footnote-9)

 Recall that a course of action is a procedural narrative about how to do something. As with any narrative, it has an implied future that can be evaluated for threat, *Ta*. If the *Ta* for a potential action is less than the *Te* for the expected future, if the action’s future is less threatening than the expected future, it is retained. If there is only one potential course of action, it is the default choice if its *Ta < Te*. If there is more than one, the action for which the positive difference *Te - Ta*is greatest is the best choice--tempered by constraints on time and effort. Indeed, these constraints often are dealt with by merely choosing the first fast, easy action for which the difference is positive (i.e., satisficing; Simon, 1955).[[10]](#footnote-10)

**Action**

 For immediate and low-intensity threats, the easiest action is immediate and brief; quick fixes involving reflexes and habits. For intermediate and extended threats, automaticity is insufficient. But, putting the threat into words—a chronicle narrative—delineates the problem, and putting the action sequence into words—a procedural narrative—allows us to talk to others about our problem and how to deal with it.Perhaps more important, language allows us to talk to ourselves about our problem and our emotional distress, and allows us to talk ourselves through the required steps to effect a remedy. Language serves to bind time, allowing consideration of the distant future right now instead of having to wait until it happens. This is what makes planning and sequential actions possible. Mitigation can begin immediately even though the threat is in the distant future. Moreover, if mitigation appears to be failing, we can talk ourselves through changing the action sequence to better fit the circumstances.

 Action implementation requires manipulations of the physical and social environments. This includes both muscular movements and symbolic acts. For example, you pull up a chair, sit down, take off your left shoe, and massage your blistered toe—physical acts to stop the pain from continuing into the future. Or, you tell your friend how sorry you are for having forgotten an appointment—a symbolic act of contrition that is successful if it makes both you and your neglected friend stop feeling negative emotions. Use of language to express sorrow, love, anger, and so on, is action (Austin, 1962: Searle, 1969) in that it causes both ourselves and other people to change future behavior in ways that that are less threatening than would otherwise be expected.

 Implementation of action produces a succession of changes in the environment that through the control system’s feedback loop are each sensed, perceived as a new event, and integrated into the narrative, thus changing its implied future—hopefully for the better. Because actions in the sequences are conditional, if an action (or series of actions—because feedback is not always immediate, especially when changing the distant future) results in the predicted future becoming more desirable by reducing the discrepancy between what is expected and what should be, the next action(s) in the sequence is executed. If this fails, new or revised action is selected from procedural memory, implemented, and monitored for its success in reducing the discrepancy.

**Choice**

 The decisions discussed above may not seem like the choices that most of us are familiar with, but they are. All familiar choices are decisions about actions and the alternative futures they offer. For example, a choice between two bicycles involves the two decisions discussed above. The first is about the discrepancy between your expectations about a bike-less future and how you would prefer that future to be (your standards). If the discrepancy is small, it means the bike-less future is acceptable; you do not need one. If the discrepancy is large, the threat of future dissatisfaction prompts the second decision, selection of a corrective action. This time the discrepancy between your standards and the future offered by each of the two bicycles is evaluated. The bike whose future is least the threating of the two (i.e., that offers the least fear of disappointment), is the best choice as long as it also is less threatening than going bike-less.

 Normative research’s gamble metaphor focuses almost exclusively on the second of these two decisions, choice of action--whether or not to bet, and in some cases, how much to bet. It never addresses the decision about whether or not to gamble in the first place (except, perhaps, within the context of research on risk aversion). In contrast, naturalistic research’s problem- solving metaphor focuses attention to choices about both threat and action—does something have to be done and, if so, what? In this regard, the naturalistic approach much more closely matches decisions made in settings other than casinos and race tracks; decisions about life and work and family and all the rest of what makes ordinary life possible.

 Anchoring the naturalistic viewpoint in narrative and control makes it even more explicitly about real life. Chronical narratives, the stories we tell ourselves and others, are the platform for decision making; how what is going on provides a glimpse of the future and how satisfactory or unsatisfactory it will be if nothing is done to change it. And procedural narratives tell us how to implement change when it is needed. Control monitors discrepancies between how things are, or will be, and how they should be, facilitating threat detection as well as choice of corrective action and monitoring of its progress as it is implemented.

 I would argue that discrepancies are the key to decision making. The drama of human life, perhaps life in general, results from anticipating threat (defined by discrepancies) and finding ways to reduce or eliminate it (monitored by discrepancies). It is difficult to think of any situation requiring a decision in which discrepancy is not at the crux. And, being ubiquitous, discrepancy should be a focus of decision research. For example, how sensitive are people to discrepancies in different circumstances and what determines their tolerance limits? Or, because threat intensity (emotional reaction) varies across individuals and circumstances, how could we map the conditions that determine it? Mapping would tell us how strongly people will react to threat under such and such circumstances and how it will drive their attempts to correct it. This could be of use, for example, to the Centers for Disease Control (CDC) for predicting public response to the threat of epidemics or to new but onerous public health initiatives. It also might useful for helping people understand and respond to climate change, perhaps by focusing less on global catastrophe and more on personal experience and its relation to broader threats to (e.g., Weber, 2006).

 Research also should focus on the stories we tell ourselves, not so much on whether they are true or false but on how they dictate what is perceived as threatening and what they dictate as corrective action. In a world riven by ideological (narrative) differences, understanding one’s own perceived threats/correctives is important lest we find ourselves driven to act in ways that create even more threats. Understanding others’ threats/correctives is important for promoting tolerance, negotiation, and compromise. Leaders need to appreciate people’s threats/correctives in order to design policies that will both address their concerns and, when necessary, calm their fears.

 Note that both narrative and control rely on causation, not probability—the mainstay of the normative viewpoint. This is because cognition is causal and causal ambiguity (uncertainty resulting from indirect causal links) is, in itself, threatening; it implies reduced control of the future and future threats. But, unless trained to do otherwise (Lejarraga & Hertwieg, 2020), decision makers’ conceptions of ambiguity do not necessarily conform to the mathematical rules of probability theory. We all use words like probably, possibly, possibility, and even probability but we seldom mean precisely the same thing a statistician would mean. And, of course, probability theory was invented as a derived procedural narrative to deal with this ambiguity, but it has developed far beyond anything useful for everyday, moment by moment, individual decision making, even if most people knew about or understood it. It just is not relevant to most everyday decision making.

**Some Closing Observations**

 Whatever disagreements I may have with the normative research movement, I must acknowledge that it has performed a very important cultural service—warning decision makers to distrust their intuitions. This is important because for the larger part of 200,000 years people’s narratives and predicted futures constituted the only truth they could know. As a result, the ready acceptance of that personal truth’s authority is deeply rooted. But, as science reveals previously undreamt of complexity in the physical world and as travel and communications reveal similar complexity in the social world, personal truth is not always sufficient. Indeed, it can be argued that the greatest threat facing individuals and societies comes from equating personal truth with universal truth and being wrong. The only defense is to temper our truths with caution and inquiry.[[11]](#footnote-11)

 That said, the normative research also has done a huge disservice. It has diminished appreciation of the marvel of human cognition, dismissing it as almost embarrassingly impaired. But, as naturalistic research repeatedly demonstrates and as the history of human thought so clearly displays, human cognition is a powerful thing. Simply look around. As individuals, we may have to grope our way forward. But collectively, we have created art, science, engineering, medicine, and all the rest. Our schools and universities, our economies, governments, and societies are monuments to the power of human thinking. Part of the naturalistic decision making movement’s appeal is its tacit acknowledgement of this power and its willingness to explore it without demeaning it. That, in my view, is the way to build a science that can contribute positively to the human endeavor.

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1. I use the word ‘decision’ to include both choice and judgment; in both cases the decision maker must select an option from a set of options. [↑](#footnote-ref-1)
2. A recent review of this conflicting research by Lejarraga and Hertwieg (2020) suggests that at least some of the difference between the earlier and later results is attributable to the nature of the tasks presented to research participants. In the earlier studies, tasks usually involved training in the quantities in question, producing a greater resemblance to normative prescriptions than the later studies, which tended to rely on more conceptually abstract tasks. See also, Cosmides & Tooby (1996) and Hertwieg, Hogarth, & Lejarraga (2018). [↑](#footnote-ref-2)
3. The ideas outlined here derive from a more detailed exploration of the role of narrative in cognition, called the Theory of Narrative Thought (Beach, 2010, 2019; Beach, Bissell, & Wise, 2017). [↑](#footnote-ref-3)
4. Mar (2004) reviewed the neuropsychological research related to story comprehension and story production, their common neural mechanisms, and the implications for cognition. [↑](#footnote-ref-4)
5. If “Time... is what keeps everything from happening at once” (Cummings, 1922), then causality is what makes anything happen at all. [↑](#footnote-ref-5)
6. See Weick (1995) for the role of narrative in sensemaking in organizations. [↑](#footnote-ref-6)
7. Limits need not be symmetrical around the reference state. If the sensed state falls only a little short of the reference state, the negative emotion may be sufficient to prompt corrective action. On the other hand, if it exceeds the reference state by the same amount, it may evoke positive emotion and no corrective action is needed. But, if it exceeds the standard by much more, it may evoke sufficiently negative emotions to trigger action; too much of a good thing is not a good thing. [↑](#footnote-ref-7)
8. Emotion is a complex topic (Lerner, et al., 2015) but the emotional response to discrepancies is the resultant of all emotions in play at the moment. [↑](#footnote-ref-8)
9. The discrepancy test is, essentially, a subjective t-test. Recall that the weaker the causal links that lead to the expected future, the greater the uncertainty about its accuracy—let *ue* be uncertainty about a particular future, *e*.  Let *te* be the threat posed by the discrepancy between that expected future, *e*, and the ideal for that future (standards), *s*. Presuming a common measure can be found for both (I suggest intensity of negative emotion), dividing the threat posed by the expected future by uncertainty about the accuracy of the expectation, *te /ue = Te*, tempers the threat such thatthe greater the uncertainty, the larger the threat (discrepancy) must be to reject the assumption that the expected future is nonthreatening and prompt corrective action.*Te* is the term used in text above. My point is that this is the same form as a one-sample t-test in which the difference between a sample mean and the population mean is divided by the sample variance and, if the result is greater than a previously specified limit, the null hypothesis is rejected.
Similarly, the test for courses of corrective action is the same form as a two-sample t-test. I submit that narrative thinking and the need for control predate statistics by many thousand years. So, the discrepancy test is the original t-test and the statistical version is simply codified intuition with a few more bells and whistles. Perhaps Man is an intuitive statistician after all. [↑](#footnote-ref-9)
10. Incidentally, one’s narrative is the entirety of one’s understanding about what is going on. Decisions are both informed by and constrained by that understanding. In short, the bounds of the narrative and the focus on discrepancies establish the bounds of ‘bounded rationality’ (Simon, 1957). [↑](#footnote-ref-10)
11. On the other hand, I have taught or observed a great number of classes in which the dangers of heuristics, biases, and human fallibility have been preached and I have yet to see much impact on student’s confidence in their own decisions. Like so many of us, they are willing to believe that everyone else suffers from these deficiencies, but not themselves. Even the researchers who decided that everyone makes bad decisions seem quite confident about their decision. [↑](#footnote-ref-11)