

Journal for the History of Analytical Philosophy

VOLUME 12, NUMBER 7 (2024)

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ISSN 2159-0303

jhaponline.org

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The Habitual Horizon Ramsey on Cognition and Forecasts

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ABSTRACT

At the end of Frank Ramsey's "General Propositions and Causality" ([1929b] 1990), he offers an enigmatic footnote that briefly describes his philosophy of science as a "forecasting theory". What he means by this and by a "forecast" is unclear. However, elsewhere in his unpublished notes, he uses the term sporadically. An examination of those notes reveals the skeleton of a behavioral theory of mind. Ramsey held that all actions are at root driven by the sum total of a person's dispositions or habits. These habits operate in an unconscious process that produces psychological expectations about the realization of desires. When those expectations are frustrated, the violation is registered consciously to the individual as a proposition, and the offending habit is identified. Humans can then regulate and change those habits by the conscious application of logic through deliberation. The applicable logic is Ramsey's decision theory, which aims to make beliefs probabilistically coherent by adopting the laws and chances that signify the habits people might use for guiding behavior. The outcome of this deliberation is to refashion psychological expectations as mathematical expectations on laws and chances. These mathematical expectations are forecasts, and a forecasting theory of science takes scientific theories to provide forecasts.

1. Introduction

Frank Ramsey has had a tremendous influence in philosophy thanks to prominent contributions in mathematical logic, the philosophy of probability, and the philosophy of science. Over the past thirty years, there has been an increased interest in connecting his work to American pragmatists like C. S. Peirce and William James; in several essays starting with "Truth and Probability" ([1926b] 1990) and continuing to his death, Ramsey seems to have imbibed core early pragmatist ideas and developed

them further with a subjectivist view of probability theory (for a detailed biographical sketch, see (Misak 2020)). Among his ideas include a sophisticated philosophy of science centered around an unconventional account of general propositions. Strangely, he mysteriously describes his philosophy of science as a “forecasting theory”. These ideas are discussed in the “General Propositions and Causality” paper ([1929a] 1990), where Ramsey articulates a new view of universal propositions such as “Arsenic is poisonous” and “All men are mortal” along with a discussion of causal laws. He lists a series of notes at the end of the paper. The first of those notes explicitly describes his philosophy of science as a “forecasting theory”:

As opposed to a purely *descriptive* theory of science, mine may be called a *forecasting* theory. To regard a law as a summary of certain facts seems to me inadequate; it is also an attitude of expectation for the future. The difference is clearest regarding chances; the facts summarized do not preclude an equal chance for a coincidence which would be summarized by and, indeed, lead to a quite different theory. (Ramsey [1929a] 1990, 163)

What Ramsey means by a “forecasting theory” is enigmatic. He does connect laws to expectations about the future, and he also connects chances as well. But beyond that, he says nothing nor does he say anything in this paper and other finished writings. More can be said, however, in his notes. Ramsey mentions in a series of notes about existential judgments that forecasts are very important:

Question. What is the meaning in test of acquaintance?

Suggestion. The fundamental proposition is the forecast then the memory. (Ramsey 1929b, 6)

Here he links forecasts with meaning, acquaintance, and memory. The last part is important: it suggests that forecasts are related to cognition or how humans think.¹ Elsewhere in his notes when he discusses memory,

¹To be clear, Ramsey’s theory here is not “cognition” as it might be understood in the later twentieth century and contemporary philosophy of mind about the computational manipulation of representations. Instead, what Ramsey has in mind is a theory of mental economy and behavior. It is too strong to call him a behaviorist but it is also too anachronistic to attribute to him ideas that developed following the cognitive revolution of the 1960s. The use of “cognition” or “cognitive psychology” here is meant to be more general about how mental processes produce behavior and have content—if any—through their connection with behavior.

he also discusses cognition generally. This suggests that the key to understanding what Ramsey means by a “forecast” is to understand how he thinks human cognition works.

It appears that at the end of his life, Ramsey had begun to sketch a theory of cognitive psychology and to connect it with the scientific theories and laws construed as a “forecasting theory”. Given his importance in the development of twentieth-century pragmatism and analytic philosophy and the continued relevance of pragmatism to contemporary philosophical thought, it would be worthwhile to explore this theory of cognitive psychology to understand better the type of pragmatism he gravitated towards at the end of his life.

Ramsey’s pragmatism has received a great deal of discussion in the secondary literature. One important part of that discussion is the relationship between habits, behavior, and science. This is relevant because, in his earlier writings, he proposed a theory of cognitive psychology centered around successful habits in action. Multiple authors note Ramsey’s commitment to the view that belief is a form of habit or disposition to act, which is first expressed in the essay “Truth and Probability” ([1926b] 1990, 65); and they connect this view of belief to Ramsey’s idea that our psychology produces behavior by weighing our beliefs with our desires—an idea also first expressed in “Truth and Probability” ([1926b] 1990, 69); and they note that in the same essay, Ramsey argues that habits are evaluated based on the degree to which they lead to reliable action per the facts ([1926b] 1990, 91–92).² Sahlin connects Ramsey’s discussion of habits with expectations by noting that habits lead to expectations and those expectations are right or wrong according to the degree to which they match the actual observed frequencies (Sahlin 1990, 48–50). For example, my expectation that a yellow mushroom is poisonous is driven by my disposition to eat or avoid yellow mushrooms, and that expectation is correct to the degree to which it matches the actual frequency of yellow poisonous mushrooms. Similarly, Dokic and Engel describe Ramsey’s pursuit of “human logic” and its connection between how habits produce behavior and behavioral adequacy in terms of its ability to reliably lead to success in action, where reliable success in action means having true beliefs about the

²Sahlin notes that the ideas seem to have had their origin in another unpublished paper that Ramsey wrote in reaction to the *Tractatus* (Sahlin 1990, 48).

properties of things in proportion to the frequency of those things in fact having those properties (Dokic and Engel 2002, 27–28). Lastly, Misak argues that Ramsey adopts wholesale Peirce’s view on habits and their relationship between behavior, expectations, and science. She argues that Ramsey came to view laws as a type of habit and that the laws of a scientific theory are good only insofar as the habits they produce match the observed frequency of facts (Misak 2016, 182). Views like this are common throughout the literature on Ramsey’s understanding of habits, behavior, and their relationship with science and induction.

Returning to the question of what a forecast happens to be, the natural suggestion from this literature is that forecasts are habits that reliably lead to success in the exact sense they make predictions in the future that match the observed frequencies, and a forecasting theory is a scientific theory that produces forecasts.

The main problem with this account is that it misattributes Ramsey’s view about the relationship between habits and science in “Truth and Probability” to the view developed in his later essays starting with the *On Truth* manuscript and continuing through “General Propositions and Causality”. Ramsey gives up on this view in a short piece titled “Reasonable Degree of Belief”:

When we pass beyond reasonable = my, or = scientific, to define it precisely is quite impossible. Following Peirce we predicate it of a habit not of an individual judgment. Roughly, reasonable degree of belief = proportion of cases in which habits leads to truth. But in trying to be more exact we encounter the following difficulties. (Ramsey [1928a] 1990, 97)

He argues that what is meant by a “reasonable” credence cannot be made more exact except in the sense of it being my credence or a “scientific” credence. He then criticizes the rough and ready definition proposed in “Truth and Probability”³ by claiming its exactness is an illusion after

³That view is given in the section titled “Human Logic” where Ramsey advocates for a logic above and beyond the probability calculus that aims to fix partial beliefs by reality. His proposal occurs in several places but the typical passage cited is as follows:

Let us take a habit of forming opinion in a certain way; e.g. the habit of proceeding from the opinion that toadstool is yellow to the opinion that it is unwholesome. Then we can accept the fact that the person has a habit of this sort, and ask merely what degree of opinion that the toadstool is unwholesome it would be best for him to entertain when he sees it; i.e. granting that he is going to think always in the same

enumerating the attendant difficulties of making it exact.⁴ Consequently, he reasons “there is no point in fixing on a precise sense of ‘reasonable’” (Ramsey [1928a] 1990, 97). So a forecast as a reasonable expectation, i.e., a degree of belief that matches the correct frequency of true cases, admits of no exact sense and so is no clarification of the term “forecast” as it is used in “General Propositions and Causality” and Ramsey’s notes.⁵ What Ramsey is abandoning here is precisely the view he articulates in “Truth and Probability”, and the remainder of the document discusses an alternative view where rationality is not about being in accordance with the facts but about achieving a degree of self-control. The upshot is that when Ramsey connects “forecast” to cognitive features like memory, he is not rehashing a theory of cognitive psychology from his earlier writings but developing something new.

The secondary literature has not explored this alternative cognitive psychology Ramsey seems to have worked on from 1928 and 1929. As mentioned, most accounts focus on the aforementioned view defended by Ramsey in “Truth and Probability”—ignoring any possible change of thought that occurred in the last years of his life; this is understandable because as I will argue below, there are certain continuities between the earlier view and later views—in particular the emphasis on linking habits and expectations. However, there is a lack of discussion about how habits

way about all yellow toadstools, we can ask what degree of confidence it would be best for him to have that they are unwholesome. And the answer is that it will in general be best for his degree of belief that a yellow toadstool is unwholesome to be equal to the proportion of yellow toadstools which are in fact unwholesome. (Ramsey [1926b] 1990, 91)

The idea is that a degree of belief is best or reasonable about whether a particular yellow toadstool is unwholesome just in case it agrees with the frequency of unwholesome yellow toadstools.

⁴The reasons why boil down to the account requiring there to be facts about fictional entities like hypothetical habits and chances. He lists the reasons as 1) the actual habits are not admissible because experience might have been misleading, so I must consider hypothetical habits, 2) the actual cases are not admissible due to their rarity (I may never test the habit so must consider how it would have been tested), 3) they require admitting chances into reality when the world has no such things, 4) they require general habits that have chances that could turn out wrong, and 5) induction ultimately should not appeal to chance (Ramsey [1928a] 1990, 97).

⁵Dokic and Engel mistakenly take this to be an argument for the old view expressed in “Truth and Probability”, and they cite this passage erroneously in support of their view. However, the fact that Ramsey says “reasonable” cannot be defined precisely and then lists difficulties with his old definition pushes against their interpretation.

relate to expectations and mental acts like judgments. While various authors do reference Ramsey's seeming commitment to a functionalist theory of mind, they develop this theory little. Sahlin alleges in passing that Ramsey has a view analogous to the representational theory of mind, but he fails to discuss the evidence for that view or to elaborate more fully on it (Sahlin 1990, 78–80). Dokic and Engel ascribe a functionalist theory of belief to Ramsey, but they do not go into considerable detail or discuss Ramsey's broader theory of cognitive psychology (Dokic and Engel 2002, 24–25). They do discuss the relationship between beliefs and desires for Ramsey, and they suggest Ramsey would have had to be a kind of coherentist about beliefs and desires in the sense they depend on one another (see section 4.5 in (Dokic and Engel 2002, 62–64). Both Sahlin and Dokic and Engel cite Loar as working out this theory in detail, but Loar mainly identifies Ramsey as thinking some mental states need to play the causal roles of belief and desires without further elaboration on what those roles happen to be (Loar 1980, 65–68). Additionally, Skorupski (1980) and Hookway (1980) only briefly discuss Ramsey's theory of psychology in passing while discussing more modern developments in the philosophy of belief. Later authors like Misak largely ignore a psychological theory Ramsey might have had except noticing as previous commentators that Ramsey is seemingly committed to a belief and desire coherentism (Misak 2016). In short, Ramsey's theory of cognitive psychology is genuinely underdeveloped in the secondary literature.

The key project in this paper is to develop that theory and explore Ramsey's views as they progressed in 1928 and 1929. My core contributions are to develop in more detail how habits function in Ramsey's proposed cognitive economy, including how they interact with memory, how expectations are supposed to lead to the fundamental propositions of what Ramsey elsewhere calls the "primary system", and how logic helps expectations lead to forecasts. Importantly, this is a partially reconstructive project since Ramsey never wrote a complete paper or book on the project. However, it is worth developing because it sheds light on a relatively obscure but novel pragmatism about the purpose of philosophy and logic. That pragmatism—had death not intervened—would likely have been explored and defended in a book-length project titled *Truth and Probability* that Ramsey was working on in his final years of

life (Misak 2020, 383–84). I aim to develop an important philosophical component of that pragmatism by exploring Ramsey's underlying theory of cognitive psychology, and its fruitful application to a philosophy of logic and science.

The central component of Ramsey's theory of cognition is the psychological expectation. Psychological expectations are the anticipations of experiences, whether rewarding or punishing. They are both the product of human cognition and also the transmission driving behavior. Cognition produces psychological expectations through an unconscious integration of habits, and cognition is changed by registering violations of those expectations. A violated expectation constitutes a proper proposition. The truth or falsity of those propositions can then be used to deliberate on the habits that generate future expectations.

Habits or dispositions to act are the rules humans use for building psychological expectations. These habits act collectively unconsciously; an expectation is the sum product of every habit. Ramsey analogizes the process through which habits produce expectations to how the automatic telephone dials different households. Like the telephone, this dialing process is associative and largely invisible to people; it is stored in a largely inaccessible memory system. Only when those expectations are violated are the habits driving those expectations examinable.

The process of examination occurs consciously. Here violated expectations constitute the proper propositions. These are the propositions of the primary system. They admit to being true or false. When a violation occurs, the mind can identify the offending habits, and both the offense and offender are stored in an accessible memory system. Deliberation can then proceed on how to modify those habits. This occurs via the application of logic.

Like Peirce, logic is a means of self-control for Ramsey. It is how the conscious process of deliberation changes the habits that lead to psychological expectations. For Ramsey, the correct logic is his decision theory. Violated expectations are treated as proper propositions while habits are treated as laws and chances. The process of deliberation involves fitting those propositions and habits into a coherent system of credences. This means forcing psychological expectations to act as mathematical expectations.

Psychological expectations behave as mathematical expectations according to some adopted laws and chances are forecasts. Beliefs in propositions are treated as weighted averages over laws and chances. The weights here are subjective degrees of belief about the trust an agent puts in the laws and chances. When the forecast is purely epistemic, i.e., when the agent only cares about the truth of the forecasted propositions, these expectations are just equal to probabilistic predictions given by a mixture of the laws and chances an agent thinks possible. Thus when Ramsey says his theory of science is a forecasting theory, he means that the point of science is the production of laws and chances and methods for weighing those laws and chances in forecasts. A theory of science is a forecasting theory just in case it is useful for making decisions.

Before I begin, I want to provide a cautionary note about what follows. Ramsey never authored a complete paper discussing his theory of cognition. Most of what follows is a reconstruction from his notes informed by the more mature philosophy in his published papers. So I want to emphasize that this is partially speculative, and I am uncertain whether this account is correct. I have put forward the evidence, and I believe this is the most likely theory of cognition that reflects Ramsey's thoughts in 1928–1930.

Here is how my argument proceeds. First, I argue that Ramsey views human cognition as proceeding via unconscious and conscious processes. The meeting point for these processes is psychological expectations. Second, I discuss how the two processes relate to Ramsey's philosophy of logic as self-control. This view of logic Ramsey inherited from Peirce. Finally, I discuss how this leads forecasts to be regimentations of psychological expectations as mathematical expectations. The upshot is that a forecasting theory of science holds science to be a method of decision-making.

2. The Cognitive Model

Ramsey has a rudimentary theory of cognition in his notes. The key components of that theory are two processes that work together to produce psychological expectations. The first process is unconscious in the sense that humans are not aware of it, and it is not open to immediate introspection. In contrast, the second process is defined by awareness

and the ability of humans to introspect. Awareness is the key dividing line. It is what separates dispositions from acts.

In Ramsey's unpublished book manuscript, he lists the content of the unconscious and conscious processes to be dispositions or acts:

The most important of these [states of mind] is that between *acts* and *dispositions* . . . When we say he knows he's got to leave or he knows his multiplication table, we are talking of enduring dispositions of his mind, manifested at times in particular acts of knowing, but conceived as existing even when not so manifested, just as a man is called courageous even when not at the moment displaying his courage . . . But we also have other words which refer not to dispositions but to definite dateable (but not necessarily instantaneous) acts of mind. Thinking, as in "I was just thinking that it's going to rain," . . . judging, inferring, asserting, perceiving, discovering and learning all refer to acts not to dispositions. (Ramsey 1991b, 98)

Ramsey divides mental states into acts and dispositions. Starting with the former, he considers dispositions to be claims like knowledge about multiplication tables. These are not claims about the world in the sense when I say I know how to do multiplication that I have multiplied all numbers; instead, my claim about knowing multiplication is a claim that if the right circumstances were presented, I could successfully multiply the presented numbers. In contrast, acts are definitive mental events. Here he considers judgments, assertions, perception, and learning as examples. If I correctly implement a multiplication algorithm in my head, this would be a mental act.

The division between acts and dispositions tracks the split between conscious and unconscious processes. The content of the conscious process is mental acts, while the content of the unconscious process is dispositions. Together these direct and produce behavior.

Two elements of cognition link the conscious and unconscious processes: expectations and memory. I treat expectations first.

2.1. Psychological expectations

Starting with acts, also called "judgments", Ramsey is clear that acts include more than the result of resolutions of doubt. He writes that

It has been said that judgment is a decision reached from doubt, and presupposes a preliminary process of inquiry and indecision; in ordinary

language this may be so, but we shall use the word much more widely so as to include any form of thinking that, whether it be a reasoned conclusion or a guess or a prejudice or a memory or a presentiment or anything else whatever of the same general type. Judgment in our usage presupposes no process of reflexion or weighing of evidence; we may reflect and weigh the evidence before we judge but only too often we jump to a conclusion without any such process. (Ramsey 1991b, 46)

No reflection is necessary for a judgment; it is not the abatement of doubt. He uses judgment to include any sort of mental act that is not a disposition. They are mental events.

This means mental images also count as acts. He goes even further, listing other non-linguistic mental representations along with images as judgments:

Let us take next the case in which he does not say anything to himself but merely has an image of Jones' face. In this case, it still seems to me that this image, just like the words in the last case, would be or express a judgment . . . But suppose he neither said anything to himself nor had an image [in reaction to seeing a man's back], what then? In this case there are, I think, two possibilities: first that he made a judgment of some other kind or in some other way [or second, it could be a disposition]. (Ramsey 1991b, 48)

Acts have propositional content but many of these acts are non-linguistic. In the case of seeing someone's back, the act of thinking can be linguistic (an inner monologue), imagistic (associating the back with the person's face), or neither (some association about who it is). Therefore, propositional content can be had in mental imagery and other forms of intuition that occur as mental events.

What distinguishes acts from dispositions generally is that the act is part of a conscious—aware—process that leads to actions. Ramsey considers the case of seeing someone's back. If there is an explicit event, linguistic or not, that leads to an action and is crucial for that action, then it counts as an act:

The conclusion we have come to is this: if his seeing the back led either to his saying to himself "Hallo, there's Jones" or to his having an image of Jones' face of such a kind or with such accompaniments that it issues in action, then we must say he made a judgment. (Ramsey 1991b, 49)

Mental acts are tied to actions. They have to be somewhere upstream in the process of decision-making. As discussed previously, this means

that "accompaniments" can count as acts. Ramsey goes so far as to include even associations: "An immediate (conditioned reflex) response to a stimulus can be in our view a judgment provided it is a response in thought (e.g. words or images) and not in action" (Ramsey 1991b, 50).⁶ I will argue below that their role in issuing actions is through surprise and conscious deliberation. So what makes an act an act is its conscious connection to action. This means that things as diverse as associations and perceptions can count as mental acts.⁷

But how are actions determined? Ramsey provides the same response throughout his writings. Actions are determined by beliefs in combination with desires: "[A person's actions] result from his desires and the whole system of his beliefs, roughly according to the rule that he performs those actions which, if his beliefs were true, would have the most satisfactory consequences" (Ramsey 1991b, 45). Here Ramsey's whole system of beliefs includes dispositions.⁸ So actions are determined by a combination of previous mental acts and current dispositions and desires. The result is what I call a psychological expectation.

These psychological expectations—the production of actions from beliefs and desires—underpin the truth-aptness of mental acts. Ramsey writes that the distinction between acts with propositional reference (propositional content) and dispositions arises from how the former are connected to surprise in action:

The idea that a piece of conduct has one particular propositional reference only arises when one of the beliefs on which it is based turns out to be mistaken. In general the beliefs on which we act are true, but when just

⁶In contrast, if it does not, then it is properly characterized as a disposition: "If on the other hand he acted directly on seeing the back without any such intermediary process, then there was no judgment, although we might perhaps say that his response manifested or was due to a belief function" (Ramsey 1991b, 49–50).

⁷On perceptions, Ramsey divides them into acts and dispositions too:

The same distinction can be applied to the problem of how far judgment is involved in perception. That a sensation causes us to act, [or leaves a trace which enables us to remember its quality] does not necessarily mean that we judged it to have a certain quality; nor is this involved in its leaving a trace which enables us to remember it afterwards. Whether indeed we could properly say that we perceived that something was so and so, whether we said to ourselves that it was or not, we have according to our definition a judgment. (Ramsey 1991b, 50)

⁸He makes this clear in an earlier draft (Ramsey 1991b, 100).

one of them turns out to be false, as for instance when the Union has moved, our attention is fixed on that one and our conduct condemned as erroneous in one particular respect. (Ramsey 1991b, 99–100)

Attention focuses on the behavior and in doing so produces a judgment or mental act. The psychological expectation issues the mental act. The conscious mind attends to violations of dispositions—habits—because those habits produce an expectation of satisfaction for the consequences the habit is supposed to lead to. For example, I believe it will not rain today and thus omit my umbrella when walking out the front door. But I then get wet walking to my job. This focuses my attention on the mistaken belief “It will not rain today”. My surprise results in a mental act, but that act happens only because my disposition that it will not rain led to an expectation that was violated, i.e., getting wet.

It is crucial to understand that psychological expectations and the acts they produce are intimately tied to the satisfaction of desires. What makes the psychological expectation an expectation is that it anticipates the satisfaction of some desire. When that desire is frustrated, the anticipation is in error, and it reveals the content of the belief as a mental act by showing how the belief is false. This is subtle. Ramsey is pointing out that the way beliefs (considered as propositions) are false is fundamental to individuating them by the propositional content of those beliefs.⁹ One cannot merely show when the belief is true; one needs to know when the belief is false. This is a problem that bedevils contemporary, naturalistic accounts of propositional content.¹⁰ His solution is to tie falsity to frustration or disutility in action.

To illustrate how Ramsey’s theory works, it would be important to briefly discuss his theory of the truth-conditions of belief in a proposi-

⁹Astute observers will notice a close resemblance here between this view of expectations and William James’s view that the true ideas are those on which our belief rides; they are those that ultimately lead to a satisfaction of desires (James 2004). This might seem perplexing given that Ramsey appears to reject James’s pragmatism in the *On Truth* manuscript. I would like to clarify that Ramsey is rejecting the James as read by Russell and company at Cambridge (see (Misak 2016) for a discussion about whether they understood James correctly), but that it is unclear that this is what James meant. Regardless of the correct interpretation of James, what Ramsey is emphasizing here is that I cannot make my beliefs true simply by believing them but in whether I am in fact successful in action; what is emphasized here is that incorrect beliefs will fail and my desires will be frustrated.

¹⁰For example, Dretske identifies it as *the* problem for information-theoretic accounts such as his. This is sometimes described as the problem of misrepresentation (Dretske 1988).

tion.¹¹ Ramsey outlines the basic theory in “Facts and Propositions”, and he adheres to this theory in *On Truth*. The idea is that the content of a proposition is its truth-conditions, and the truth-conditions of a proposition are the causes and effects that follow from the actions taken if the proposition is believed.¹² More specifically, those causes and effects are the causes and effects on utility. Ramsey gives the example of the behavior of a chicken contemplating the proposition of a caterpillar being poisonous:

In order to proceed further, we must now consider the mental factors in a belief. Their nature will depend on the sense in which we are using the ambiguous term belief: it is, for instance, possible to say that a chicken believes a certain sort of caterpillar to be poisonous, and mean by that merely that it abstains from eating such caterpillars on account of unpleasant experiences connected with them. The mental factors in such a belief would be parts of the chicken’s behaviour, which are somehow related to the objective factors, viz. the kind of caterpillar and poisonousness. An exact analysis of this relation would be very difficult, but it might well be held that in regard to this kind of belief the pragmatist view was correct, i.e. that the relation between the chicken’s behaviour and the objective factors was that the actions were such as to be useful if, and only if, the caterpillars were actually poisonous. Thus any set of actions for whose utility p is a necessary and sufficient condition might be called a belief that p , and so would be true if p , i.e. if they are useful. (Ramsey [1927] 1990, 40)

Ramsey notes that belief is ambiguous and how it is interpreted will fix what the mental factors happen to be. For example, belief might be

¹¹Propositions for Ramsey are not independent entities but really a name for what he calls the propositional reference of a belief. I will use “proposition” and “belief” interchangeably here.

¹²Another interpretation of Ramsey’s theory of the propositional reference of belief is that this propositional reference is not determined by its truth-conditions. However, I think there is considerable evidence from “Facts and Propositions” that the content of a proposition is given by its truth-conditions: namely Ramsey’s use of Wittgenstein’s truth-tables to elaborate on the meaning of molecular propositions. This method requires identification of when atomic propositions are true or false since it uses truth-functional logic to build the truth-conditions of more complicated propositions like conjunctions and disjunctions. Ramsey proposes that the causes and effects of the atomic propositions jointly characterize the rows of the truth table and so provide the meaning of the more complicated, molecular propositions (Ramsey [1927] 1990, 45–46). This means the meaning of molecular propositions is given by their truth-conditions, which would require the same for the atomic propositions.

understood to include the “feeling” of belief or the emotional effect of the belief, which would have to be included in the mental factors when analyzing that belief. However here, Ramsey considers what might be considered *pragmatic* belief or belief as it is understood that leads to action. His thought is that the truth-conditions for the chicken’s belief that the caterpillar is poisonous are the facts relating to the chicken’s behavior now and in the past with the objective facts associated with that behavior. This is abstract so consider the decision matrix in figure (1) for Ramsey’s chicken. The columns of the matrix correspond to the state proposition whose truth-conditions are to be defined, the rows are the actions the chicken might take, and the cells in the table are the consequences of those actions on the states. What Ramsey is saying here is that the cells determine the truth-conditions for the proposition “The caterpillar is poisonous” and its complement. These are the causes and effects alluded to earlier. They are connected with the belief by the actions taken. A belief that “The caterpillar is poisonous” is true if and only if the action the chicken takes leads to the satisfaction of desires. Here, if the chicken believes that proposition the expected desire to be satisfied would be “The chicken avoids having an upset stomach” because the chicken would refrain from eating. And the same applies to the proposition’s complement, where if the chicken believes “The caterpillar is edible”, it will eat the caterpillar and find itself to be satiated. So the truth-conditions of the proposition are the relations given by the decision matrix between the belief, actions, and consequences of those actions.

	The caterpillar is poisonous.	The caterpillar is edible.
Eat the caterpillar.	The chicken has an upset stomach.	The chicken is satiated.
Refrain from eating the caterpillar.	The chicken avoids having an upset stomach.	The chicken missed a good meal.

Figure 1: A decision matrix for the caterpillar thought experiment. The columns are the proposition or state of the world. The rows are the actions. The cells are the consequence or outcomes of the states and actions. The original rendition of this matrix can be found in Sahlin (1990, 72).

Crucially, it is just as important what happens if the chicken mistakenly believes the caterpillar to be poisonous or edible. In that case, the belief could be rendered false because the chicken will have missed a good meal or had an upset stomach—clearly worse outcomes by the chicken’s

own light. Its desires would have been frustrated. This is why Ramsey mentions the importance of prior experience in the passage: the chicken has the belief that the caterpillar is poisonous when it refrains because it previously ate a caterpillar that gave it an upset stomach or has a model that doing so would lead to an upset stomach. The truth-conditions here include more than just the success conditions of the chicken’s action but also the failures the chicken would encounter should it judge poorly. A belief about something cannot be well-formed unless one knows when the belief is false.¹³ This is why Ramsey emphasizes that mental acts are formed after violations of expectations. Here in this example, the expectation is given by the matrix of state, action, and outcome. This can be seen in figure (2), which gives the utilities of the various actions on propositions. The action is taken in anticipation of the reward given by the outcome. So that would mean that when the chicken believes the caterpillar is edible, it will eat the caterpillar and if it thinks the caterpillar is poisonous, it will refrain from eating the caterpillar. That expectation is violated when the expected outcome does not match the actual outcome; the chicken winds up with an upset stomach or having missed a delicious meal. In the above table, the false conditions are given by the alternative row in the column that is the actual state. Supposing the belief of the chicken is that the caterpillar is poisonous, it takes the action to refrain from eating given by the dark gray row. However, it finds itself having forgone at least one utility because the caterpillar is in fact edible, and so it missed the outcome given in the light gray cell. If the true truth-condition for the belief “the caterpillar is poisonous” is given by the beneficial outcome of avoiding a stomach ache due to the chicken’s cautiousness, then the false truth-condition for the belief “the caterpillar is poisonous” is given by a poorer outcome of missing a good meal due to refraining when the chicken could have been satiated. In short, the slogan for truth-conditions of belief in a proposition is they are the outcomes given by the action with the highest expected value for that proposition. So both true and false truth-conditions are the outcomes driven by the beliefs actions and the utilities over consequences. Falsity

¹³While it has been pointed out by Sahlin and Dokic and Engel that the truth-conditions are given by the highest utility cells of the decision matrix, I believe they have omitted the importance of the cells where utility is lower (Sahlin 1990, 72); (Dokic and Engel 2002, 14). These are the cells that fundamentally individuate propositions: they tell agents when those agents are wrong.

plays just as important a role here as truth. Thus, Ramsey's theory for truth-conditions more importantly applies to the falsity conditions of propositions: it is baked into his model of how mental acts are produced and cognition proceeds via psychological expectations.¹⁴

	The caterpillar is poisonous.	The caterpillar is edible.
eat	$U(\text{upset}) = -1$	$U(\text{satiated}) = 1$
refrain	$U(\text{avoid}) = 0$	$U(\text{miss}) = 0$

Figure 2: A decision matrix illustrating a proposition's truth-conditions as a relationship between action and utility. Here the truth-condition for the falsity of the belief that "the caterpillar is poisonous" is the outcome of missing a good meal because in refraining from eating, the chicken has an outcome different than avoiding a stomach ache. In essence, the chicken having a false belief about the caterpillar being poisonous suffers the consequence of forgoing a good meal.

The picture then is that mental acts are differentiated from dispositions by their possession of propositional content. This makes them truth-apt. Their propositional content comes from their role in producing actions and connection to success and frustration in action. The production of those actions comes from a combination of those mental acts in conscious deliberation, dispositions, and desires. This result I call a psychological expectation. Psychological expectations can be violated—people can be surprised or frustrated—and this leads to the further production of mental acts. This suggests that what differentiates mental acts in terms of their conscious deliberation is their connection to how expectations can be violated.

This leaves open two questions: how are dispositions involved in the generation of psychological expectations and what is relevant about the conscious part to mental acts in their production of expectations? I discuss these in turn.

¹⁴This relationship between the content of beliefs and a belief's success or failure in action has led some scholars to describe Ramsey as an early success semanticist (see Mellor's introduction in (Ramsey 1990) and Dokic and Engel's extended discussion (Dokic and Engel 2002)). While he certainly influenced the theory of success semantics as it developed in the late twentieth century, I will be silent over this except to say that like the success semanticist, Ramsey thinks that the content of a belief, its truth-conditions, are related to success and failure in action.

2.2. Unconscious process

Dispositions for Ramsey operate consciously and unconsciously, though the majority of their operation occurs unconsciously when people act unreflectively. These are the habits that govern human behavior, and they operate below awareness; most beliefs of this sort are not consciously attended to but only arise in reaction to events. This suggests an unconscious process that governs much of human action. Here I discuss that process and its relationship to the generation of psychological expectations.

The central metaphor for the unconscious process is the automatic telephone. By automatic telephone, Ramsey is referring to the then-new telephone technology that allowed the connection of callers without an operator. These are electro-mechanical devices that proceed via simple rules or programs for connecting callers. In discussing the understanding of a sentence, Ramsey comments that the automatic telephone illustrates part of the cognitive process very well:

The automatic telephone indeed illustrates some aspects of thought very well; but not the e.g. understanding the words and so the sentence, and if it were not so good it might illustrate failure to understand if you dialed too fast. (Ramsey 1929c, 3)

Ramsey applies the metaphor to understanding words and sentences, but one can infer from this that it applies elsewhere in thought too. The metaphor exhibits the fact that behavior is the result of habits: "the human mind works essentially according to general rules or habits" (Ramsey [1926b] 1990, 90). The habits are the particular network switches that can result in observed calls, i.e., the observed mental acts. They appear to be associative in the sense that they connect behaviors. So the central metaphor of the unconscious process is an automatic connection between mental acts.

These dispositions or habits have to be stored and retrieved somehow. Ramsey argues there is "secondary memory" that contains the dispositions, which are normally not directly accessed and hidden:

There is primary memory but time could be known without it. Secondary memory is like perception: I can look into the past or not according as I like; but what I see is not chosen by me.

...

Most of our mental processes lie below a threshold, which I can always open and let them through; indeed what keeps them out is generally merely crowding of the stage of consciousness by other ideas. (often each just shows its fact but not its whole body). I know what I mean in the sense that I can always when challenged open the door and let an account of it in. (Ramsey 1929a, 22)

The passage above is somewhat oblique, but one can reconstruct from it the core claim that habits are stored in a different, secondary type of memory. Ramsey mentions a “secondary memory” and how it is like perception in that one cannot choose what one sees from it ordinarily, and then on the succeeding line documents how “most of our mental processes lie below a threshold”; combined with the earlier claim that habits are in large part unconscious, this would suggest that habits, like most of the inaccessible mental processes of the human mind, are similarly inaccessible as the stuff in secondary memory is mostly inaccessible. Consequently, this suggests habits lie stored in a “secondary memory” that is sealed off from ordinary introspection. Sometimes people gain access to it, and this allows people to think about the habits that govern behavior. But most of the time, it is impenetrable to perception and inaccessible.

Furthermore, the use of the name “secondary memory” is meant to separate how habits are stored from how mental acts are stored. I will discuss Ramsey’s primary memory more in the next section, but here it is important to keep the two separate. One is accessible to conscious perception while the other is not. This is why Ramsey thinks of them as two separate systems.

Ramsey believes these dispositions in memory to be identifiable with brain states. They are the product of some fact about a person’s brain, what he calls traces:

So also in the case of the boy who knows the date of the Conquest, we must suppose his knowledge to depend on some arrangement, ‘trace’ or ‘record’ in his mind or brain, which is formed when he learns the date and persists until he forgets it, his forgetting being simply the disappearance of this trace.

These traces, or in different cases other formations, constitute the positive qualities from which dispositional knowledge and beliefs are derived, but most of us have no idea as to what sort of structures or modifications the traces are, and take them simply as unknown causes which bring it about that if for instance we ask the boy for the date he tells us

correctly. So when we are trying to explain as at present what we mean by knowledge, etc. we have no concern with the real nature of these traces but merely with the kind of thoughts or actions which they are supposed to cause. Just as in explaining the meaning of strength, we have only to explain what is meant by supporting a strain without breaking, not what properties of a body they are which enable it to support a strain. (Ramsey 1991b, 44)

Secondary memory is a physical process whose stored habits are some physical state in the world. The dispositions then are dependent, like the strength of a metal, on those physical states and how they work. This is a story for neurophysiology. So dispositions for Ramsey are ultimately fictions of a sort, and their guidance in behavior can be described mechanically in terms of some particular facts about peoples’ brains.

The separation between primary, conscious memory and secondary, unconscious memory is also important because Ramsey believes the conscious system operates differently from the unconscious system. Namely, the unconscious process generates behavior holistically.

A person’s unconscious process generates behavior from every habit stored in secondary memory. This means that habits cannot be isolated from one another when a psychological expectation is formed. In other words, behavior is the result of every disposition, and one cannot say that a particular habit results in a particular behavior:

[I]t is not possible to take a piece of my conduct and regard it as having a definite propositional reference in the same way as a piece of my thinking has. Take my going to Bridge Street; in <doing> this we said I behave as if the Union were there, but also as if the Union had a library, and as if the book I wanted were contained in that library but in no other nearer one from which I could borrow <it>, and as if the library would still be open and so on indefinitely. My conduct is the result or manifestation of my whole system of dispositional beliefs. (Ramsey 1991b, 99)

Actions are the result of every belief that is a disposition. They cannot be isolated. Ramsey argues that this follows from the fact that psychological expectations are a product of beliefs plus desires:

The assertion we make about [a person’s] behavior is evidently a very complicated one, for no particular action can be supposed to be determined by this belief alone; his actions result from his desires and the whole system of his beliefs, roughly according to the rule that he

performs those actions which, if his beliefs were true, would have the most satisfactory consequences. (Ramsey 1991b, 45)

Since Ramsey assumes that behavior is the result of beliefs and desires, it follows for him that every disposition has to factor into every action, i.e., every expectation. This is a fundamental thesis of Ramsey's, and the thesis dates back to his "Truth and Probability". There he makes the crucial assumption that behavior must be treated fictionally as the product of a person's beliefs and desires.¹⁵ Here that assumption remains. Interestingly, he has localized this assumption to dispositions; mental acts need not contribute to every behavior. This is crucial because it is another way to separate conscious mental acts from unconscious habits: acts only selectively result in action while habits generate action collectively.

So if habits collectively produce behavior and they are stored in an inaccessible secondary memory, how do people access them?

Ramsey argues that access comes from how dispositions issue in acts and how they affect our expectations:

The dispositional beliefs manifest themselves in two ways: firstly by giving rise to corresponding judgments when occasion arises for making them, and secondly by governing our actions, roughly according to the

¹⁵Ramsey needs a way to measure partial beliefs in "Truth and Probability" and to accomplish this he proposes that people act in such a way as to maximize their expected value in their actions. However, he notes that this is at best an approximation and so strictly speaking is a fiction:

In order therefore to construct a theory of quantities of belief which shall be both general and more exact, I propose to take as a basis a general psychological theory, which is now universally discarded, but nevertheless comes, I think, fairly close to the truth in the sort of cases with which we are most concerned. I mean the theory that we act in the way we think most likely to realize the objects of our desires, so that a person's actions are completely determined by his desires and opinions. This theory cannot be made adequate to all the facts, but it seems to me a useful approximation to the truth particularly in the case of our self-conscious or professional life, and it is presupposed in a great deal of our thought. (Ramsey [1926b] 1990, 69)

He notes that maximizing expected value ignores complications from psychology about how behavior is dictated by more than just peoples' opinions and desires, and he later cites the relevance of unconscious processes in bringing about behavior. He then concludes the passage by comparing this assumption to using Newtonian mechanics in physics—even though strictly speaking that theory is false, i.e., a fiction.

rule that we perform those actions which if our beliefs were true would have the most satisfactory consequences. (Ramsey 1991b, 100)

The case of judgments will be dealt with further down through the use of logic, but the case of behavior is important because it highlights an important connection between the dispositions of the unconscious process and the conscious mental acts they produce: the latter surface when the former are violated.

Ramsey writes that only mental acts—the aware mental states present in the conscious process—have proper propositional reference and thus can be true or false:

It is clear that in common language both acts and dispositions can be called true or false, and that both have in some sense propositional references. But it seems also clear that the fundamental use of true and reference is that in which they are applied to acts, for whatever is the correct account of dispositions, they must obviously be defined by reference to the acts in which they are manifested (or would be manifested if occasion arose), and the truth or falsity of the disposition arises from that of the acts and not vice versa. (Ramsey 1991b, 98–99)

The content of dispositions is derivative of the content of acts. Mental acts are true or false; dispositions are not. This relates to Ramsey's earlier comment that dispositions are fictions that stand in for the unknown brain traces responsible for behavior. It also relates to the fact that dispositions collectively generate behavior; their "meaning" is dependent upon other dispositions and the particular mental acts they produce. So it follows that if they do not refer to a physical process but a fictional abstraction of some process, they have no propositional reference outside of the acts they issue.

In summary, the unconscious process consists of the dispositions or habits that collectively generate behavior. These habits are stored in an inaccessible secondary memory, whose physical implementation is some trace in the brain. Because Ramsey subscribes to the theory that actions and expectations result collectively from beliefs and desires, he thinks that these habits holistically produce behavior. They cannot be isolated from one another; they are not truth-apt.

This tells a particular story about how dispositions aid in the generation of psychological expectations and behavior. Dispositions collectively factor into expectations in a way that particular mental acts may not. So

the first question is answered: dispositions produce expectations only together.

2.3. Conscious process

I now need to answer the second question: what makes a person's awareness of his mental acts relevant for decision-making. Ramsey argues that mental acts factor at least selectively into expectations. How is this different from dispositions? After all, Ramsey wants to separate a mental act from a disposition by its role in generating a specific psychological expectation. Every disposition is involved with every action and expectation. So what exactly makes acts different from dispositions? The answer is that they play an important role in the deliberation performed by the conscious process.

The conscious process involves the mental acts identified by violations of our expectations. It is these mental acts that Ramsey thinks are the subject of the beliefs that have truth and propositional reference. By propositional reference, Ramsey means what the belief is about:

Now whether or not it is philosophically correct to say that they [beliefs] have propositions as objects, beliefs undoubtedly have a characteristic which I make bold to call *propositional reference*. A belief is necessarily a belief that something or other is so-and-so, for instance that the earth is flat; and it is this aspect of it, its being "that the earth is flat" that I propose to call its propositional reference. (Ramsey 1991b, 7)

Putting some of the earlier remarks about psychological expectations and their role in connection to habits, one can infer the relationship between habits or dispositions and mental acts as a side-effect of violations of those expectations. Because dispositions can only be identified through the violation of expectations and the creation of a mental act, the disposition is said to have propositional reference and truth or falsity derivatively. This can be seen in the prior section because dispositions are to be taken as a whole; they cannot be identified in any individual behavior but only become discernible when the mind reflects on them relative to a goal. When goals are frustrated, as when expectations are violated, the mental act that results can be then used in a deliberative process to identify the derivative content of the dispositions that led to the frustrated goal.

The conscious process is inherently deliberative. It is important, however, to state that mental acts need not be the result of deliberation. They just need to be involved somewhere in a deliberative process, whether they register the initial violation of expectations or subsequent reasoning over that violation. This makes mental acts the bearers of the primary system propositions. Ramsey lists several items he considers to be knowledge. Since knowledge for Ramsey is just a species of mental act, mental acts can then be direct in the sense they do not require argument as in the case of "perception, memory and insight into abstract truths" (Ramsey 1991b, 59) or they can be indirect in the sense that they do require explicit argument (Ramsey 1991b, 57).

The mention of memory is important because the conscious process has its own memory through which mental acts are stored. This is the so-called "primary" memory discussed earlier. Those contained in memory are binned in the past, which becomes important for the process of deliberation due to deliberation's connection to action and cause and effect. Importantly, unlike secondary memory, primary memory is consciously accessible and can be easily brought to attention during deliberation. It is its accessibility that makes it the primary memory and repository of mental acts.

With primary memory, deliberation can proceed. Critically, the point of deliberation is a recalibration of psychological expectations; these expectations are the determinant for actions. So deliberation is done for action.

Deliberation is done in a manner to generate laws to act by, which come to form the basis of dispositions. Ramsey writes that "when we deliberate about a possible action, we ask ourselves what will happen if we do this or that" (Ramsey [1929a] 1990, 154). It is in this process of deliberation that people form habits based on what propositions they can make true, i.e., what actions can lead directly to mental acts.¹⁶ The conscious process deliberates based on the mental acts stored in memory

¹⁶This is probably why Ramsey seems to subscribe to the now-named Ramsey Thesis:

This seems to me the root of the matter; that I cannot affect the past, is a way of saying something quite clearly true about my degree of belief. Again from the situation when we are deliberating seems to me to arise the general difference of cause and effect. (Ramsey 1991b, 158)

He thinks that one's credences about the past should not change based on what action one decides to perform. People are essentially future-directed.

and given through perception, which enables it to know what is and is not settled. The settled propositions are found in the acts in the memory, those in the past. The not-settled propositions are anything not in the memory. By surveying the possible laws that would show how unsettled propositions might follow from the settled ones in memory, behavior can be adjusted through the adoption of those rules that terminate in future desired acts.

The laws adopted following deliberation are initially a mental act—an act to choose to adopt a law—that eventually through practice is formed in secondary memory. Ramsey does not have an explicit theory for how this proceeds, but the outline goes like this. A mental act such as a judgment that a law is correct leads to a conscious sequence initially when that rule is deployed. This is partly what Ramsey means by how acts factor into decision-making; an action has to be conducive to actions by controlling future actions in some respect. By repetition, this deliberative, conscious act can eventually be done unconsciously as a fully formed habit. Slowly over time, those habits are built up and stored in memory. From there, they factor along with other dispositions in forming psychological expectations and actions. So initially laws require deliberate acts, and they eventually are subsumed in secondary memory.

By reflecting on what can and cannot be settled by mental acts, deliberation changes dispositions. In particular, the dispositions that led to a violation of expectations and the resulting mental act can be adjusted based on this reflective process. This is to gain a measure of self-control. Ramsey writes that

Self-control in general means either

(1) not acting on the temporarily uppermost desire, but stopping to think it out; i.e. pay regard to all desires and see which is really stronger; its value is to eliminate inconsistency in action;

or (2) forming as a result of a decision habits of acting not in response to temporary desire or stimulus but in a definite way adjusted to permanent desire. (Ramsey [1928a] 1990, 99)

The key idea is the formation of habits in (2) and that can only be done through the first process (1). The conscious process receives and stores violated expectations as mental acts. Those mental acts have a propositional reference, which allows us to identify the content of the rules that produced the expectation. A person stores those acts in

memory, which allows for the difference to arise in awareness between those propositions that are settled and those that are not. This enables a deliberative process that can identify new habits to replace those that led to the violated expectation. If this process is fully general, then it is logic.

2.4. Summary

Summarizing Ramsey's model of cognition, he distinguishes between two fundamental types of cognition: mental acts and dispositions. Acts are distinguished from dispositions via their role in conscious deliberation and their specific contribution to individual actions. Collectively, acts and dispositions result in psychological expectations. Dispositions work together to produce every psychological expectation but acts only contribute to specific expectations. Dispositions are largely inaccessible, except when expectations are violated and actions are frustrated. They dwell in a secondary memory that cannot be introspected. In contrast, acts are registered whenever there is a violation of expectations, and they reside in conscious memory. People can deliberate over those mental acts. They can then use deliberations to adopt new habits, which eventually are transmitted into the unconscious memory.

One way to understand Ramsey's model of cognition is as a primitive version of a two-process theory. System One consists of quick-acting, unconscious habits that generate the lion's share of a person's behavior. System Two amounts to a slower, conscious executive control of behavior by contemplating how experiences require a behavior change. Behavior is produced jointly as a function of habits and desires in System One, and System One's outputs are modified by the active involvement of System Two. The result of this process is the psychological expectations. Importantly, System Two has an attention system that is only activated when those expectations are violated. When attention dwells on a violated expectation, it can use it to intervene in future expectations. This is what imbues those violations with propositional content: their ability to be utilized in deliberation for behavior control.

3. Logic as Self-Control

Ramsey's model of cognition is a two-process system where one system produces behavior through associations stored in the brain and the other system modulates behavior by intervening on those associations in response to frustrated desires. This second system of executive control can be more or less successful at modulating behavior. How successful it is depends on what procedure it follows. Some procedures are better than others in the sense that they apply to more cases. The most general case is one where following the procedure for fixing behavior has guarantees. Logic is the most general method or collection of methods. So logic is a method of self-control at the most general.

The goal of this section is to argue that Ramsey believes that logic is the most general method of self-control. The logic he proposes is exactly his decision theory. And the final goal of this decision theory is to regiment psychological expectations as mathematical expectations.

For Ramsey, self-control comes in two varieties. It is either pausing to deliberate or enforcing habits decided on previously:

Self-control in general means either

(1) not acting on the temporarily uppermost desire, but stopping to think it out; i.e. pay regard to all desires and see which is really strong; its value is to eliminate inconsistency in action;

or (2) forming as a result of a decision of action not in response to temporary desire or stimulus but in a definite way adjusted to permanent desire.

The difference is that in (1) we stop to think it out but in (2) we've thought it out before and only stop to do what we had previously decided to do.

(Ramsey [1928a] 1990, 99)

Ramsey holds self-control to consist of two parts. The first is the act of deliberation on how to make one's action coherent; the second is to pause in acting to follow the plan outlined in the first part. I characterize the first as *finding a regimentation* and the second as *acting out the regimentation*. By regimentation, I mean a series of choices that differ from existing choices. One can think of it as something like what is called a trigger-action plan: when presented with a specific trigger, perform this action instead of what naturally occurs.

Logic applies in both finding a regimentation and acting out a regimentation.

Self-control through deliberation needs a guide for deliberation. The desired guide better work in the sense that it applies across all possible cases one might encounter. Logic aids here because of its generality:

So also logic enables us

(1) Not to form a judgment on the evidence immediately before us, but to stop and think of all else that we know in any way relevant. It enables us not to be inconsistent, and also to pay regard to very general facts, e.g. all crows I've seen are black, so this one will be—No; colour is in such and such other species a variable quality. Also e.g. not merely to argue from $\phi a . \phi b \dots$ to $(x).\phi x$ probable, but to consider the bearing of $a, b \dots$ are the class I've seen (and visible ones are specially likely or unlikely to be ϕ). This difference between *biased* and *random* selection.

(Ramsey [1928a] 1990, 99)

Ramsey's point is that logic aids in finding all the relevant propositions to ensure one is consistent. This includes both singular propositions and general propositions. This includes inductive inference on the general propositions one believes and finding the right reference class for observed propositions.

The most important point here is the claim about consistency. By consistency, Ramsey includes deductive consistency and probabilistic coherence. The generality of logic helps here because it aids in going from particular instances to variable hypotheticals. Since deliberation requires adjusting habits, one needs to identify problematic general propositions. That can only be done by thinking in general terms, which logic allows one to do. After all, the point of the deliberative process is to settle on new habits, i.e., general propositions, to adopt. So generality is required for successful regimentation and logic provides generality.

Once a new set of general propositions is adopted in deliberation, the corresponding habits need to be implemented in behavior. Logic aids here as well:

(2) To form certain fixed habits of procedure or interpretation only revised at intervals when we think things out. In this it is the same as any general judgment; we should only regard the process as 'logic' when it is very general, not e.g. to expect a woman to be unfaithful, but e.g. to disregard correlation coefficients with a probable error greater than themselves. (Ramsey [1928a] 1990, 99)

Ramsey's point here is that when acting out the regimentation, the act needs to be the same across any successive regimentation. I am

following logic in sticking to my agreed-upon habits when I have a general procedure—with a corresponding general proposition—I adhere to as I slowly nudge my behavior to incorporate the desired habit. Logic provides the generality necessary to guide the process of regimentation.

It should be emphasized that this view of logic requires logic to provide *dynamic* guidance of behavior. Beliefs must be continually monitored across time to ensure they stick to the agreed plan of regimentation. So the logic here needs to have generality both for abstracting the rules of that regimentation across its instances and for governing behavior across time. This means that the logic here has to be diachronic.

Contemporaneous notes by Ramsey accentuate his trend to viewing logic as more expansive than deductive logic and even his synchronic decision theory from “Truth and Probability”.¹⁷ In the “Weight or Value of Knowledge” manuscript (see (Ramsey 1991a, 285–87)), Ramsey proves a theorem that justifies why it is better to be more informed when making a decision as opposed to less informed. As Skyrms discusses, this result and another indicate that Ramsey was aware of the importance of what is now called probability kinematics (Skyrms 1990, 93–96). It also points to Ramsey’s interest in developing a diachronic logic. The aforementioned need to enforce regimentation across multiple acts would require a theory of logic more substantial than deductive logic.

The upshot is that logic for Ramsey is decision theory. It is a decision theory that can provide the most general tools for both finding a regimentation and acting out the regimentation.

Logic for Ramsey then must be normative in the sense that it prescribes how to change behavior without describing actual behavior. When deliberating, I use logic to theorize about my habits, my psychological expectations, and the violations of those expectations. So far, I have described deliberation as a descriptive, psychological process. With logic, I consider my deliberation as an approximation to the ideal process given by logic. This requires me to make fictitious, theoretical

¹⁷Ramsey in “Truth and Probability” articulates a need for a more expansive logic than given by formal logic, which he alternatively dubs “human logic” or “the logic of truth”. He then proposes a preliminary account for how “human logic” must connect degrees of belief with the facts through frequencies. As I have argued, this notion of “reasonable” credence had been abandoned by Ramsey in 1928, and Ramsey seems to have focused on how formal logic acts as a method for regulating behavior according to a person’s instrumental goals. This naturally leads to a type of logic that extends across time instead of at single moments.

assumptions about how I decide on an action. Logic goes beyond my own actual behavior by focusing on the habits and rules I have buried somewhere in my unconscious process. I postulate fictional propositions that stand in for those habits. After all, how is a habit evaluated for its efficacy in accomplishing my goals? It is not a proposition, but logic would demand it to be one. These fictions are general propositions.¹⁸ Their fictionality means that when I use decision theory to guide my regimentations, I am not describing how my actual behavior works.

This makes Ramsey’s later views on logic different from his earlier views. And he says as much. His decision theory, which he took to be more descriptive in “Truth and Probability”, cannot be viewed that way. It would be meaningless to do so:

The defect of my paper on probability was that it took partial belief as a psychological phenomenon to be defined and measured by a psychologist. But this sort of psychology goes a very little way and would be quite unacceptable in a developed science. In fact the notion of a belief of degree $\frac{2}{3}$ is useless to an outside observer, except when it is used by the thinker himself who says ‘Well, I believe it to an extent $\frac{2}{3}$ ’, i.e. (this at least is the most natural interpretation) ‘I have the same degree of belief in it as in $p \vee q$ when I think p, q, r equally likely and know that exactly one of them is true.’ Now what is the point of this numerical comparison? how is the number used? In a great many cases it is used simply as a basis for getting further numbers of the same sort issuing finally in one so near 0 or 1 that it is taken to be 0 or 1 and the partial belief to be full belief. (Ramsey [1929c] 1990, 95)

Ramsey admits that he had made a mistake in “Truth and Probability” treating partial belief as a psychological phenomenon. He states that he mistakenly took partial belief “as a psychological phenomenon to be defined and measured by a psychologist”, which means that it is not purely a descriptive phenomenon for research by psychology. He argues that credences are useless to an observer except maybe to compare to their degrees of belief and the logical structure of those personal credences. For example, Jones hearing that Smith believes it will rain to credence

¹⁸Ramsey discusses how universal propositions like “All men are mortal” are not true propositions in “General Propositions and Causality”, and so must be treated fictionally as propositions in logic. He writes “If then it [a universal proposition] is not a conjunction, it is not a proposition at all” (Ramsey [1929a] 1990, 146). The same reasoning applies to existential propositions and all general propositions.

two-thirds can only assess what that means in terms of his (Jones's) own personal credence assignments of two-thirds or equivalent assignments; Jones might, for instance, consider the exclusive propositions about the location of a coin under three cups and conclude that each cup has a one-third probability of concealing the coin and so the probability of the coin being in the first or second cup is the same as assignment in his own credence structure as Smith assigns the proposition it will rain. Ramsey's point is that credences only have meaning subjectively and so are not objective psychological phenomena to be measured by the psychologist. At best, they can be cashed out in how someone, like Jones, would think certain bets fair relative to what he cares about. But importantly this means that when viewed retrospectively, they amount to a claim about how a person might make bets relative to being rational in precisely the sense that that person is trying to maximize their expected value; Jones finds his credence assigns two-thirds to the coin being under the first or second cup because if he wants to act rationally, that credence should show up in how he bets, i.e., what actions he takes, relative to maximizing his expected value. So when a person talks about another person having a certain credence, this is reflective of how the former takes the other to be acting rationally, i.e., normatively—not descriptively as the psychologist would have it. It is not a descriptive fact of the other person, but a regulative feature of what he would do should he try to be coherent.¹⁹

The meaning of credences is thus personal in the sense that it only makes sense in the context of introspection. That introspection is just the conscious process of adjusting psychological expectations. Ramsey says this is practical decision-making, and the recommendation of logic is the mathematical expectation:

¹⁹One might wonder why one should accept a remark Ramsey makes in a note compared to a longer article like "Truth and Probability". Three things suggest one should. First, the note was written after "Truth and Probability", indicating a change of mind. Second, "Truth and Probability" was never published during Ramsey's lifetime likely because Ramsey was unsatisfied with it (see (Misak 2020) for a discussion). Third, some of the views Ramsey espouses in "Truth and Probability" have very stark philosophical problems. For example, Ramsey suggests in "Truth and Probability" that a reasonable credence is one that matches the relative frequencies. However, this has the reference class problem: what is the reference class of propositions to compare the credence to? Is the right reference class for my credence about whether it will rain tomorrow the frequency of rain throughout the year or the summer or Sundays?

But sometimes the number [credence] is used itself in making a practical decision. How? I want to say in accordance with the law of mathematical expectation; but I cannot do this, for we could only use that rule if we had measured goods and bads. But perhaps in some sort of way we approximate to it, as we are supposed in economics to maximize an unmeasured utility. The question also arises why just this law of mathematical expectation. The answer to this is that if we use probability to measure utility, as explained in my paper, then consistency requires just this law. (Ramsey [1929c] 1990, 95)

Ramsey claims that the practical use of credences comes through using them to determine behavior "in accordance with the law of mathematical expectation". That is, one should want a decision to behave as a mathematical expectation, a sum of utilities weighted by their probabilities. However, this is impossible since a person will lack a measure of his utilities. The solution is to approximate, but Ramsey does not mention how this would be done—though he does allude to how humans supposedly approximate it as assumed by economics. While I am speculating here, the method of approximation might be by considering only a limited number of choices, i.e., worlds, as economics does in considering a person's preferences over a limited, perhaps non-exhaustive set of goods and services. This set is treated as exhaustive and the resulting utilities are taken to approximate the true utilities that would be had by considering all worlds. Those utilities are then weighted by the probabilities—a mathematical expectation.

The thought is that instead of considering all possible options, only a limited selection is chosen and a rough preference order is assigned over them. This corresponds to assigning a utility that is within some epsilon of a true utility function. Then an approximate expectation is selected.

Ramsey argues this must be done to ensure consistency (probabilistic coherence). The desirability of consistency is that it prevents Dutch books. And this applies across any decision. So the use of mathematical expectation in practical decision-making is a part of logic.

This then is a normative account of logic. The core prescription that Ramsey thinks logic provides, among other things, is the regimentation of decisions per the mathematical expectation. This will by necessity be an approximation. But it will work well enough when finding a regimentation and when acting on a regimentation. Logic is then a

form of self-control that people use to steer action to accomplish goals. Agency is not a description but an ideal people approximate when aiming at their goals.

4. Forecasts

I have been reconstructing Ramsey's theory of cognitive psychology and philosophy of logic. These two accounts are complimentary; Ramsey's philosophy of logic is premised on a particular model of human cognition. The goal is to use these two to figure out how Ramsey's philosophy of science is a forecasting theory. The answer is that a forecast is just a regimentation of psychological expectations as mathematical expectations. A forecasting theory of science is a theory that describes how science should augment decision theory for regulating expectations. This proposal has much in common with the old view—namely, it prescribes that psychological expectations must be “reasonable” in some sense, and it says that sense of “reasonable” must factor in science somehow. However, what is different with my proposal is that a forecast *involves regimentation through deliberation that terminates in a mathematical expectation*, and a forecasting theory of science shows how scientific theories are considered in those mathematical expectations instead of in a relationship between that expectation's degrees of belief and the observed frequencies in the facts.

There are several pieces in play at this point: a two-process theory of cognition, psychological expectations as the product of that two-process theory, logic as the most general method for self-control, decision theory as logic applied to expectations, and mathematical expectation as the guidance that decision theory provides for directing behavior. These all fit together to recommend a theory of self-control.

Ramsey's core conception of any philosophy is that it must aid in clarifying thought and guide action.²⁰ A philosophy of scientific theories must do this. How can any philosophy elucidate thought and so better action? This requires a theory of thought and its connection

²⁰He writes clearly in 1929 that “Philosophy must be of some use and we must take it seriously; it must clear our thoughts and so our actions. Or else it is a disposition we have to check, and an inquiry to see that this is so; i.e. the chief proposition of philosophy is that philosophy is nonsense” (Ramsey [1929b] 1990, 1).

to action. Ramsey's two-process theory does that: it shows how beliefs as dispositions and as mental acts collaborate along with desires to produce actions. Those actions are psychological expectations about the fulfillment of desires and goals. So for philosophy to better thought and action, it must help in controlling dispositions, mental acts, and psychological expectations.

What does it mean to clarify thought and guide action? Ramsey's psychological theory says it means aiding the conscious process in deliberation and follow-up. However, this aid must be general in the sense that it applies to any possible scenario a human might encounter. A core feature of logic is its association with such absolute generality. This means that logic can be applied as a method of self-control by finding regimentations and acting on those regimentations. Consequently, for philosophy to illuminate thought and action, it must be a form of logic implemented by the conscious process.

The recommendation of logic for thought and action is given by decision theory. Decision theory says a person's behavior should be a mathematical expectation of some probability and utility function. Now this cannot be achieved in practice because a utility function cannot be found via introspection over every possible hypothesis. Instead, people can approximate their utilities by looking at a reduced hypothesis set and simulating their preferences over that set. This results in an approximate mathematical expectation as logic's recommendation for the correct regimentation of psychological expectation. Consequently, the philosophy of science must show how science can help the conscious process regiment psychological expectations as approximate mathematical expectations.

It would be useful to go into a little more depth with this idea. Since logic for Ramsey is decision theory, a forecast is the logical analog to the psychological expectation, and a psychological expectation is the result of dispositions and prior mental acts together that produce further mental acts, then the forecast has to be the mathematical expectation that produces acts in decision theory. This fits nicely with the claim that Ramsey makes from “Truth and Probability” that with decision theory I hypothesize that my behavior is the product of my beliefs and desires:

I propose to take as a basis a general psychological theory, which is now universally discarded, but nevertheless comes, I think, fairly close to the

truth in the sort of cases with which we are most concerned. I mean the theory that we act in the way we think most likely to realize the objects of our desires, so that a person's actions are completely determined by his desires and opinions. (Ramsey [1926b] 1990, 69)

Ramsey regiments this psychological theory with the idea that those beliefs and desires produce acts by the mathematical expectation:

I suggest that we introduce as a law of psychology that his behaviour is governed by what is called the mathematical expectation; that is to say that, if p is a proposition about which he is doubtful, any goods or bads for whose realization p is in his view a necessary and sufficient condition enter into his calculations multiplied by the same fraction, which is called the 'degree of his belief in p '. (Ramsey [1926b] 1990, 70)

Ramsey's suggestion in "Truth and Probability" is that in measuring a person's credences, one treats them as acting according to the psychological law of maximizing expected utility—the psychological law given by the mathematical expectation. Shifting from "Truth and Probability" to Ramsey's views in 1928 and 1929, one can eliminate the talk here that this is a psychological law instead of a logical law. Reconstructing Ramsey's thought to include some form of deliberation in decision-making, the idea then is that I treat my psychological expectations as approximate mathematical expectations in the process of deliberation. That deliberation allows me to isolate my credences in propositions, based on my utilities ascribed to those propositions.²¹ Utilities are approximated subjectively through preferences over gambles in a case of limited options. This is not psychological but reflective: I am seeing how hypothetical actions I would take cohere together. Through this reflective process, I use logic to successively regiment my expectations as mathematical expectations, and I can rely upon the same approximations with successive decisions to ensure the original expectation is adhered to. So reconstructing Ramsey's views in light of his earlier attitudes and what he says in his final papers and notes, Ramsey's cognitive psychology makes mathematical expectations the natural recommendation of logic for how to govern psychological expectations.

²¹This would naturally require revising Ramsey's decision theory so that it becomes more like Jeffrey's where probabilities and utilities are measured on the same objects, i.e., propositions. Such a reconstructed decision theory takes me far from the task at hand, but to see one way to do it, see (Bradley 2001).

The result is a forecast with credences and utilities. In the case where only what is true matters, those utilities can be treated as the indicator function:

$$\begin{aligned}\mathbb{E}[P | E] &= \Pr(P | E)I(P) + (1 - \Pr(P | E))I(P^c) \\ &= \Pr(P | E)(1) + (1 - \Pr(P | E))(0) \\ &= \Pr(P | E)\end{aligned}$$

where E is the conjunction of any observed propositions, and $I(\cdot)$ is the indicator function that returns 1 if the proposition is true and 0 otherwise. The upshot is that the expectation on this particular utility function returns the probabilities or exact predictions a coherent person would return. In short, logic regiments beliefs through the mathematical expectation.

These regimentations are forecasts. The philosophy of science is a forecasting theory precisely in the sense that it shows how science factors into the production of forecasts; it is a normative theory for action. So what do scientific theories provide?

Scientific theories provide laws and chances; a law or chance is nothing more than a habit. They are the logical rendition of the dispositions in the unconscious system largely responsible for psychological expectations. Ramsey says laws are habits in "General Propositions and Causality" when discussing a particular law "all men are mortal":²²

To believe that all men are mortal—what is it? Partly to say so, partly to believe in regard to any x that turns up that if he is a man he is mortal.

The general belief consists in

(a) A general enunciation, (b) A habit of singular belief.

These are, of course, connected, the habit resulting from the enunciation according to a psychological law which makes the meaning of 'all'.

(Ramsey [1929a] 1990, 148–49)

Laws are habits. So from the above model of cognition, they are the components of the unconscious system that are mostly responsible for psychological expectations. Logic treats these habits as general propositions. Consequently, scientific theories produce general propo-

²²Ramsey uses the phrase "law", "variable hypothetical", and "universal proposition" interchangeably throughout "General Propositions".

sitions, which are habits, and these habits govern behavior through psychological expectations.²³

The picture provided here is one where a forecasting theory produces forecasts. Forecasts are regimentations of psychological expectations as approximate mathematical expectations. A forecasting theory of x shows precisely how x can produce forecasts. In the case of science, Ramsey's forecasting theory aims to show how scientific theories produce laws, and how those laws are to be used in the production of forecasts.

It remains to be argued how my story fits with the available evidence. I turn to that now.

The principal evidence is the passage I cited at the start of this paper. In "General Propositions and Causality", Ramsey describes his philosophy of science as a forecasting theory as opposed to a descriptive theory:

As opposed to a purely *descriptive* theory of science, mine may be called a *forecasting* theory. To regard a law as a summary of certain facts seems to me inadequate; *it is also an attitude of expectation for the future* [emphasis mine]. The difference is clearest in regard to chances; the facts summarized do not preclude an equal chance for a coincidence which would be summarized by and, indeed, lead to a quite different theory. (Ramsey [1929a] 1990, 163)

Two observations should be made. First, Ramsey explicitly talks about laws as "an attitude of expectation for the future". This is very close to what I have proposed where laws are habits instrumental in the formation of psychological expectations.²⁴ The "expectation" Ramsey uses here has to be psychological expectations. Second, Ramsey contrasts his theory with a "descriptive" theory. He would only do this if his theory is meant to be normative or prescriptive. This fits closely with his view of logic as a prescriptive method of self-control; his philosophy

²³This clearly connects forecasts with conditionals, since Ramsey describes laws here as a type of conditional. Understanding how humans defer to these conditionals and what type of conditionals they are is an important component of Ramsey's theory that needs to be addressed. There has been considerable work looking at this question. See (Misak 2016) and (Dokic and Engel 2002) for a good overview of the scholarship in this area.

²⁴The secondary literature has long documented the future-looking aspect of laws. In this regard, my theory is not different from established views; what is different is that my theory states how Ramsey envisions human cognitive architecture to link habits with psychological expectations, and how scientific laws act in the regimentations of those expectations as mathematical expectations.

of science is an application of logic toward how science should factor into regimenting decisions. So there is strong evidence here that for Ramsey forecasts are connected with psychological expectations, and forecasting is a prescriptive application of logic to decision-making.

Ramsey uses the phrase "forecast" in two other places. The first occurs in his notes on "Solipsism". He argues against people being automata because he uses his own experience to forecast their behavior:

I do not believe other people are automata; for I use my experience to forecast their action, and to eliminate experience from this process of inference and recast it in terms of unknown bodily states would be too far fetched. Is X an automaton is apt to seem an absurd question? but not as meaningless but simply because the answer is no (unless there is reason to think so). If I made a man I should suppose him to have consciousness by same cause same effect unless there were reason to contrary. (Ramsey 1991a, 68)

The note here is somewhat fragmentary so what can be said about it is somewhat speculative. Ramsey associates forecast here with a process of inference. This fits well with the idea that forecasts are a type of psychological expectation. Here that expectation must factor in his own conscious experiences. Furthermore, the forecast here applies a principle of same-cause same-effect; a principle that Ramsey's comment indicates should be one that people adopt. Taking this to apply more broadly than just the narrow case discussed here in the note, one can infer a connection between "forecasts" and prescriptive expectations: a forecast is a prescriptive formulation of expectations.

The second use in his notes is the quoted passage from earlier connecting forecasts with psychology:

Question. What is the meaning in test of acquaintance?
Suggestion. The fundamental proposition is the forecast then the memory. (Ramsey 1929b, 6)

This is fragmentary but some work can be done to connect it to the reconstructed theory discussed so far. Importantly, the topic Ramsey addresses is the meaning of the test of acquaintance. He suggests cryptically that the fundamental proposition happens to be forecasts and then memories. One thing that should be noted immediately is that the question is not the meaning of acquaintance but the test of acquaintance. Ramsey uses a similar phrase in "Theories" when

he considers an alternative way of defining theoretical propositions: “the meaning of a proposition about the external world is what we should ordinarily regard as the *criterion* or *test* of its truth” (Ramsey [1929d] 1990, 122–23). The association of “test” with “criterion” in the meaning of a proposition suggests the same association here. That means that Ramsey is asking what is the meaning of the criterion of acquaintance. This is a prescriptive question: what does it mean for something to count and not count as a criterion or test for being acquainted? My account provides an answer here: it is how the criterion regiment expectations, i.e., affects the production of forecasts. This is fundamental to how any recommendation of logic should affect behavior; the psychological expectation is fundamental and so the prescription of changing expectations is fundamental. So the note here fits nicely with the theory I have provided.

In summary, forecasts are regimentations of psychological expectations as mathematical expectations. When those regimentations are done concerning the goal of finding the truth, the forecast becomes a regimentation of beliefs as probabilities. A forecasting theory of philosophy is focused on using logic to show how the philosophical topic can be made general to produce forecasts. In the case of the philosophy of science, this shows how theories and their laws can be used in regimenting behavior as mathematical expectations. Ramsey has provided a fundamentally normative or prescriptive theory of science. This account fits the sporadic uses throughout Ramsey’s notes.

5. Conclusion

Ramsey mysteriously describes his philosophy of science as a forecasting theory. However, he fails to say what he means by a “forecasting theory” or a “forecast”. The limited use of the term in his notes connects it to a model of human cognitive psychology that he developed in 1928 and 1929. This means that it overlaps with the views on habits and expectations he expressed in his earlier writings. However, he abandons the connection between the “reasonableness” of habits and the frequency of observed truths in the facts. The result is a view that sticks with the important connection between habits and expectations while developing

that connection through a more sophisticated cognitive model and philosophy of logic.

That model is at root a two-process system that produces what I call psychological expectations. Just as in his earlier view and as discussed in the secondary literature, a psychological expectation is the product of a person’s habits, prior mental acts, and desires. The expectation can produce further mental acts when violated. What is new in Ramsey’s theory is how those habits relate to one another and behavior, how they function in unconscious and conscious systems, and how they are regimented by the conscious system through deliberation. The habits that factor into that psychological expectation act collectively in an inaccessible unconscious system. Mental acts are violations of expectations, which means those expectations are properly true or false, and through deliberation, they have a localized role in formulating future expectations. This reflective, conscious system can then generate new habits that allow the person to be more successful at accomplishing his goals. It is this executive control that allows an agent to reason about what methods would best enable deliberation to arrive at an effective new group of habits.

The most successful method of choosing habits comes through logic. The generality of logic allows it to aid the conscious system in choosing a regimentation of expectations and sticking to that regimentation through successive actions. Ramsey recommends the logic to apply in both cases is his decision theory, and that decision theory suggests that psychological expectations must be approximations of mathematical expectations. So logic is a means of self-control by adapting psychological expectations to mathematical expectations.

When a psychological expectation is regimented as a mathematical expectation, it becomes a forecast. A forecasting theory is then a philosophy that shows how its subject matter aids in the production of forecasts; it is a branch of logic, and therefore, a prescriptive guide to action. Ramsey’s philosophy of science is precisely this because it shows how scientific theories and their laws can be used to regiment psychological expectations as mathematical expectations.

Acknowledgements

I would like to thank and acknowledge Jeremy Heis, Brian Skyrms, Jeffrey Barrett, and Kyle Stanford for their thoughtful feedback on this paper.

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