

# Risk, uncertainty and prophet: The psychological insights of Frank H. Knight

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## Abstract

Economist Frank H. Knight (1885–1972) is commonly credited with defining the distinction between decisions under “risk” (known chance) and decisions under “uncertainty” (unmeasurable probability) in his 1921 book *Risk, Uncertainty and Profit*. A closer reading of Knight (1921) reveals a host of psychological insights beyond this risk-uncertainty distinction, many of which foreshadow revolutionary advances in psychological decision theory from the latter half of the 20<sup>th</sup> century. Knight’s description of economic decision making shared much with Simon’s (1955, 1956) notion of bounded rationality, whereby choice behavior is regulated by cognitive and environmental constraints. Knight described features of risky choice that were to become key components of prospect theory (Kahneman & Tversky, 1979): the reference dependent valuation of outcomes, and the non-linear weighting of probabilities. Knight also discussed several biases in human decision making, and pointed to two systems of reasoning: one quick, intuitive but error prone, and a slower, more deliberate, rule-based system. A discussion of Knight’s potential contribution to psychological decision theory emphasises the importance of a historical perspective on theory development, and the potential value of sourcing ideas from other disciplines or from earlier periods of time.

Keywords: decision making, decision psychology, bounded rationality, prospect theory, Nobel Prize, Herbert Simon, Daniel Kahneman, Amos Tversky, *homo economicus*.

## 1 Frank H. Knight — An introduction

Frank Hyneman Knight (1885–1972) was one of the more influential economists of the early 20<sup>th</sup> century. His 1921 book — *Risk, Uncertainty and Profit* — is often credited with introducing the distinction between “risk” (known chance, or measurable probability) and “uncertainty” (unmeasurable probability, or indeterminable chance). Knight (1921) proposed that this distinction was important for economic theory, because uncertainty affords opportunities for profit that do not exist in situations where risks can be calculated.

This risk-uncertainty distinction has played an important role in economic thought and theory from Keynes (writing in the 1930s) to the present day (Davidson, 2006; Emmett, 1999). Moreover, the concepts of *risk* and *uncertainty* have played a key role in experimental psychology ever since psychologists were introduced to eco-

nomic theories of decision making by Edwards (1954) and embarked upon their own investigations of choice behavior. Knight’s distinction is explicitly acknowledged in Ellsberg’s (1961) influential exploration of decision making with ambiguous probabilities, and, most recently, in the comparison of choices involving described gambles (with specified probabilities) with choices where probabilities must be estimated from observations (Hau, Pleskac & Hertwig, 2010; Rakow & Newell, 2010). Most significantly, psychological theories of judgment under uncertainty (Gilovich, Griffin, & Kahneman, 2002; Kahneman, Slovic, & Tversky, 1982; Tversky & Kahneman, 1974) and of decision making under risk (Kahneman & Tversky, 1979, 2000; Tversky & Kahneman, 1992) have been among psychology’s most successful exports to other disciplines including economics, management science, finance and medicine (Laibson & Zeckhauser, 1998).

Thus, Knight’s (1921) distinction between risk and uncertainty has been important for psychologists and economists — and both disciplines have acknowledged this contribution. However, further reading of *Risk, Uncertainty and Profit* (RU&P) reveals a broad base of psychological ideas, which go well beyond the risk-uncertainty distinction. In a quite remarkable way, Knight seems to have foreshadowed several of the key contributions to decision theory that have been made by

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psychologists in the latter half of the 20<sup>th</sup> century. This article will explore Knight's psychological insights from a psychologist's viewpoint, and will show that some of the concepts that are key to psychological decision theory have an older heritage than we might suppose. Knight's RU&P is not the only economic text from his or earlier eras with clear psychological elements — Loewenstein (1992) points to several such examples, and argues that the border between psychology and economics was not so sharp in the 19<sup>th</sup> and early 20<sup>th</sup> centuries. Indeed, Knight began his *Preface* to the first edition of RU&P by stating modestly that: "There is little that is fundamentally new in this book" — indicating that his decidedly psychological approach to economics (illustrated below) was by no means unique. Therefore, although I focus almost entirely on Knight's RU&P, this article can be thought of as an exploration of one example (i.e., RU&P) of a sizeable class of economic writing that some decision psychologists may not have explored, yet find accessible, interesting, and potentially valuable.

## 2 Foreshadowing some major contributions to the psychology of decision making

Twice, the *Royal Swedish Academy of Sciences* (RSAS) has awarded the Nobel Prize for Economics to academics who made fundamental contributions to the psychology of decision making. In 1978, Herbert Simon was honoured for "research into the decision-making process within economic organizations" (RSAS, 1978a), embodied in the concept of "bounded rationality". Daniel Kahneman shared the 2002 Prize (with Vernon Smith) for his work with Amos Tversky (deceased 1996), which provided experimental findings showing "that basic postulates in economic theory should be modified" (RSAS, 2002). Both these bodies of work have been acclaimed as groundbreaking — yet Knight discusses key elements of both research programmes in RU&P.

### 2.1 Knight (1921) on bounded rationality (Simon, 1955, 1956)

I have been teaching my (psychology) students that Herbert Simon's notion of bounded rationality was revolutionary for economists. I have been telling them that it moved economists from a fully rational model of decision making in which all information is available — and can be considered — towards a more psychologically plausible model of human decision making that acknowledges the limitations of human cognition and the constraints imposed by the environment. It seems that I am in good

company with respect to this view. For instance, the press release for Simon's Nobel Prize (RSAS, 1978a) stated:

"What is new in Simon's ideas is, most of all that he rejects the assumption made in the classic theory of the firm of an omniscient, rational, profit-maximizing entrepreneur. He replaces this entrepreneur with a number of cooperating decision-makers, whose capabilities for rational action are limited, both by a lack of knowledge about the total consequences of their decisions, and by personal and social ties." (See also RSAS, 1978b).

In RU&P, Knight explores both of the key components of bounded rationality: cognitive limitations on the part of the decision maker, and constraints imposed by the environment. In discussing *The Meaning of Risk and Uncertainty* (RU&P, Chapter VII), Knight challenges "the assumption of practical omniscience on the part of every member of the competitive system" (p. 197). For Knight, this assumption is a "simplification of reality" (p. 197), which is (or would be) necessary to explain perfect competition. However, his thesis is that competition is not perfect, because knowledge is imperfect. Imperfect knowledge and uncertainty are inextricably linked, and are fundamental in the "divergence between costs and selling price" that creates profit (p. 198). For Knight, there is no omniscience in economic decisions:

"Hence it is our imperfect knowledge of the future, . . . , which is crucial for our understanding of our problem." (p. 198)

"We live only by knowing *something* about the future; while the problems of life, or of conduct at least, arise from the fact that we know so little." (p. 199)

Why this lack of knowledge? The two pillars of Simon's bounded rationality combine to make it so: "There are far too many objects to be dealt with by a finite intelligence" (RU&P, p. 205). However, just as for Simon (1955, 1956), this does not mean that the decision maker is destined for failure. Non-identical objects can be classified together on the basis of similarity, and so, suitable reference classes can be constructed that support the making of inferences and decisions. Moreover, classification is flexible — appealing to different properties of the object depending upon the task at hand. Hence, limited knowledge can be applied flexibly to different decision problems. More recently, flexibly-determined reference classes have been put forward as a key element in the probabilistic mental models for inference (Gigerenzer, Hoffrage & Kleinbölting, 1991) that underpin the

simple heuristics research programme (Gigerenzer, Todd, & The ABC Research Group, 1999).

Knight's description of everyday decision making shares much with Simon's world of *satisficing* agents, making "good-enough" decisions on the basis of limited information. Knight writes:

"The ordinary decisions of life are made on the basis of 'estimates' of a crude and superficial character. In general the future situation in relation to which we act depends upon the behavior of an indefinitely large number of objects, and is influenced by so many factors that no real effort is made to take account of them all, much less to estimate and summate their separate significances. It is only in very special and crucial cases that anything like a mathematical (exhaustive and quantitative) study can be made." (pp. 210–211)

This sounds many miles away from the omniscient decision maker of rational economics that we are told by some was universally accepted in the traditional economic theories of decision and choice prior to Simon's insights — and, which still retained significant influence thereafter (Gigerenzer & Todd, 1999; Thaler & Sunstein, 2008). Yet, however "new" this idea might have seemed some 30 years later, Knight (1921) seems to have regarded it as a rather obvious one. Only a little reflection is required for one to acknowledge the ubiquity of action on the basis of limited information:

"It probably occasions surprise to most persons the first time they seriously consider what a small portion of our conduct makes any pretense to a foundation in accurate and exhaustive knowledge of the things we are dealing with." (p. 210).

Of course, there is great merit in validating such insights empirically. Indeed, the 2002 Nobel Prize Committee commended Daniel Kahneman for his work on heuristics with Amos Tversky, which showed that "people are incapable of fully analyzing complex decision situations when the future consequences are unknown" (RSAS, 2002). Nonetheless, it is noteworthy that Frank Knight spoke so forcefully in 1921 against the notion that decisions depend upon full analysis of complete information.

## 2.2 Knight (1921) on prospect theory (Kahneman & Tversky, 1979)

In 1979, Kahneman and Tversky published their first paper on prospect theory — a descriptive theory of deci-

sions under risk. Prospect theory was successful in economics and psychology, because it could account for behavioral departures from the dominant expected utility and subjective expected utility models (Savage, 1954; von Neumann & Morgenstern, 1947). The descriptive success of prospect theory rests on some key psychological insights into how people respond to the value or utility of potential gains or losses, and to the probabilities associated with them.

With respect to the significance of prospect theory's conception of value, let us again look to the *Swedish Academy of Sciences*, and their appreciation of Kahneman's contribution:

"A striking finding is that individuals are much more sensitive to the way an outcome deviates from a reference level (often the status quo) than to the absolute outcome. When faced with a sequence of decisions under risk, individuals thus appear to base each decision on its gains and losses in isolation rather than on the consequences of a decision for their wealth as a whole. ... These and other results contradict predictions from the traditional theory of expected-utility maximization." (RSAS, 2002)

Kahneman and Tversky (1979) were not the first to suggest that *changes* in wealth, as distinct from *absolute* amounts of wealth, were important for decisions under risk. For instance, Edwards (1962) was careful to identify *increases* or *decreases* in utility as fundamental to the process of modeling individual decisions. However, what secured prospect theory's success was being able to show that the reference point, which determined whether outcomes were losses or gains, was not fixed. Rather, it could vary across situations according to the presentation of the problem, or the aspirations of the individual. Therefore, an outcome could be viewed as a loss or as a gain, depending upon the decision maker's outlook, which can be influenced by the framing of the choice before him or her. Importantly, when the reference point is moved preferences can change such that a different option may be chosen (e.g., Tversky & Kahneman, 1981). Whatever stir this "news" caused among economists in the 1970s and 80s, the possibility of a moveable reference point would probably have come as no surprise to Frank Knight, as suggested by the following footnote to his discussion of preference in relation to choice and the exchange of labor:

"It is too obvious to call for discussion that the same event will be a pleasure to one person and a pain to another, and even pleasurable to one person and a pain to another, according to circumstances, and, especially, expectations. The

difference fades out on scrutiny. An inheritance of a hundred thousand, which is a pleasure to one to whom it is a surprise, may be an intense grief if he has expected and made his plans for 10 million. A prison sentence is undoubtedly a source of joy to a man who counted on being hanged, and it is ridiculous to say that it is 'really' only an escape from a worse pain, or the inheritance a deprivation of a greater pleasure. . . . pleasure and pain are accidental and arbitrary matters." (pp. 63–64)

Knight does not seem to have grasped the significance of his insight into the arbitrary status of pleasure/pain or loss/gain in the same way that Tversky and Kahneman did, so successfully. Indeed, some of the most compelling support for prospect theory comes from studies which illustrate that losses and gains can be *arbitrarily* defined, simply by altering the language, or framing, of a problem (Tversky & Kahneman, 1981). In fact, precisely because their designation is arbitrary, Knight seems to have regarded pleasure and pain as incidental to economic decisions (p. 63). Nonetheless, it is remarkable that a "revolutionary" insight (i.e., reference-dependent valuation) from the latter part of the 20<sup>th</sup> century (see Laibson & Zechhauser, 1998; RSAS, 2002) was anticipated by Knight in 1921.

A second fundamental component of prospect theory is the non-linear weighting of probabilities. In expected utility theories, prospects are valued by multiplying utilities for each possible outcome and their respective probabilities. In contrast, prospect theory posits that it is *as if* values (see above) are multiplied by decision weights, and then summed to provide an overall valuation of the prospect. Specifically, prospect theory's decision weight function (for probabilities) assumes that small probabilities are often overweighted, relative to their objective value. For instance, a probability of 0.01 will not have one tenth of the "influence" of that exerted by a probability of 0.1 — it will be rather higher than one tenth (Prelec, 1998). Applying such a transformation to objective probabilities can explain the attraction of long-shot lotteries or the seduction of insuring against improbable losses (Tversky & Kahneman, 1981) — the latter phenomenon also possibly illustrating the common desire to reduce unlikely adverse events to impossibilities (the "certainty effect" — Allais, 1953).

Some readers will be aware of early empirical work demonstrating a mapping between objective probabilities and "psychological probabilities" that bear a close resemblance to prospect theory's decision weight function. Such a function, showing the overweighting of small probabilities, was implied by the laying of bets in horse races (Griffith, 1949), by auction values for lotter-

ies (Preston & Baratta, 1948), and by the willingness to bet on risky options in laboratory studies (Mostellar & Nogee, 1951). A few years later, Ward Edwards formally proposed the concept of *decision weights*: non-linear transformations of probability that could be multiplied with utilities (Edwards, 1954, 1962). However, according to Knight (1921), elements of this idea (e.g., overweighting small probabilities) seem to have been acknowledged long before the mid-20<sup>th</sup> century.<sup>1</sup> Consider his description of the typical *bias* (Knight's word) in the evaluation of risky prospects, which, again, is a long way from *unbounded* rationality:

"The problem of the human attitude to uncertainty (...) is as beset with difficulties as that of uncertainty itself. Not merely is the human reaction to situations of this character apt to be erratic and extremely various from one individual to another, but the 'normal' reaction is subject to well-recognized deviations from the conduct which sound logic would dictate. Thus it is a familiar fact, well discussed by Adam Smith, that men will readily risk a small amount in the hope of winning a large when the adverse probability (known or estimated) against winning is much in excess of the ratio of the two amounts, while they commonly will refuse to incur a small chance of losing a larger amount for a virtual certainty of winning a smaller, even though the actuarial chance is in their favor." (RU&P, pp. 235–236)

Over-valuing a long-shot lottery could be attributed to over-valuing the prize rather than overweighting the small probability of the prize. Indeed, Adam Smith (1776) writes of over-valuing the "chance of gain" in lotteries (p. 96), which, arguably, could attribute the phenomenon to either element (the prize *or* its probability). However, the context for Knight's discussion is the calculation of probabilities and the uncertainty of opinions. Moreover, when he returns to Adam Smith's observation later in RU&P, he builds to the conclusion that "these 'risks' [faced by entrepreneurs] do not relate to objective external probabilities" (p. 365). In doing so, he references two 19<sup>th</sup> century economists: Senior (early 19C) and Cannan (late 19C). According to Knight, Senior proposed that "the imagination exaggerates the large odds in favor of either gains or losses", whilst Cannan held that "both unusually risky and unusually safe investments are especially attractive" (p. 365). Thus Knight and some of his predecessors were

<sup>1</sup>Perhaps because they were writing in an era less concerned with citation, the earlier heritage of the notion that small probabilities are overweighted does not seem to be acknowledged by the other writers cited in this paragraph.

apt to adopt a distinctly psychological stance in their discussion of entrepreneurial decisions. Knight (and others) explicitly acknowledged bias or psychological transformations in the treatment of probabilities that many years later would — thanks largely to prospect theory — be formalised as decision weights and become an accepted part of psychological decision theory.<sup>2</sup>

### 3 Frank H. Knight — A decidedly psychological economist

It is remarkable how much of RU&P is in tune with recent and present-day behavioral decision research. This extends beyond the topics identified above. For instance, Knight addresses some of the broader themes of present-day decision research.

Presumably much influenced by economic theories of decision making (Savage, 1954; von Neumann & Morgenstern, 1947), psychologists have relied heavily upon the “gamble paradigm” as a model for exploring decisions under risk (Weber, Shafir, & Blais, 2004). For Knight, this would be entirely appropriate, for “it is correct to treat all instances of economic uncertainty as cases of choice between a smaller reward more confidently and a larger one less confidently anticipated” (p. 237). Indeed, as indicated in this quotation, he is explicit that the choice between gambles extends to the realm of uncertain choices, where subjective probabilities reflect beliefs or degrees of certainty — as instantiated in theories of subjective probability (Ramsey, 1926/1931; Savage, 1954). From its psychological ancestors, research into judgment and decision making has inherited a regard for the similarity between perceptual and cognitive judgment. This is perhaps best typified by the “Brunswikian” (or lens model) framework, inspired by the work of the Austrian psychologist Egon Brunswik (Brunswik, 1943, 1952; Cooksey, 1996; Hammond & Stewart, 2001), which considers cognitive judgements such as risk assessments to be reliant on cues in the environment, just as visual perception depends upon cues such as occlusion and contrast. Another common analogy with perception is apparent in the use of the term “cognitive illusions” as a synonym for some of the biases attributed to the use judgment heuristics (Kahneman & Tversky, 1996). When discussing the “mental operations by which ordinary decisions are made” (p. 211), Knight points to the similarity between reasoning by “judgment”, “common sense” or “intuition”, and the estimation of distances or weights in the absence of measuring instruments (p. 211).

In this discussion, and elsewhere, Knight points to two

<sup>2</sup>See Ashraf, Camerer and Loewenstein (2005) for a wider discussion of Adam Smith’s prescience with respect to current thinking in behavioural economics and psychological decision theory.

systems of reasoning, which differ in character and may result in different outcomes. For instance, Knight asserts that: “the opinions upon which we act in everyday affairs and those which govern the decisions of responsible business managers for the most part have little similarity with conclusions reached by exhaustive analysis and accurate measurement” (p. 230). Thus there are two kinds of mental processes: one intuitive and error prone, the other logical and reliant upon the “uniformity of nature” (p. 230) — in other words, rule-based. On this distinction, Knight resonates with several current dual system accounts of cognition, which posit: an analytical system that is effortful, rule-based and largely under the direction of conscious attention; and a quicker, low-effort intuitive system that relies on heuristics or rules of thumb (Evans, 2006; Kahneman, 2003; Kahneman & Lovallo, 1993; Sloman, 1996). Thus Knight discusses the making of predictions by means of formal probability calculations, logic and probabilistic reasoning, but contrasts this with the inscrutable “procedure of making decisions in practical life” where intuitive estimation is “subject to a wide margin of error”. He also reflects upon the apparent conflict between “hot” and “cold” cognition (Loewenstein, 1996), which results in inconsistent preferences — we often strive for things that we regret in “a calm, cool hour” of rational reflection (p. 238).

Beyond these broad themes, Knight also discusses several specific topics that are familiar to current researchers of behavioural decision making. He describes the *winner’s curse* (later discussed by Thaler, 2002) — the tendency for the “winning” bid in an auction to exceed the value of the “prize” (RU&P, p. 366). Knight discusses the role of error in judgment (p. 251), and the practical benefits of aggregating multiple judgments, which include increased accuracy in probability estimation (more recently analysed by various authors, e.g., Ariely, Au, Bender et al., 2000). He points to “an inveterate belief” in “luck” in cases where judgment is the basis for beliefs about chance (p. 236), which is prescient of the literature on overconfidence (Griffin & Brenner, 2004; Lichtenstein, Fischhoff, & Phillips, 1982), or the preference for betting on knowledge/judgment rather than betting on chance events even when expectations are equated (Heath & Tversky, 1991). Knight also alludes to, *as-if* reasoning (Ross & Murphy, 1996), the tendency to assume that the most probable outcome (as determined by an initial process of judgment) is actually a certain outcome in subsequent actions that follow the initial judgment (RU&P, p. 227).

### 4 Concluding remarks

Why should we concern ourselves with the ideas of an economist born in 1885? Have not all of the ideas dis-

cussed above found a clearer expression and a more precise application in the theories and experimentation of the past 50 years? There may be some merit in this view — nonetheless, there are benefits to studying the history of concepts, as illustrated by the case of Knight's *Risk, Uncertainty and Profit*.

First, every worker deserves his due. For those whose work is publishing ideas, it is right and proper that their part in the heritage of an idea is acknowledged. Frank Knight deserves acknowledgement for identifying and discussing several key ideas that are in current circulation. Indeed, as his modest opening to *RU&P* suggests, many, perhaps all, of these ideas may pre-date 1921. Nonetheless, we perform a disservice if we lose sight of the source of the concepts that are part of current psychological or behavioral decision theory.

Second, reading *RU&P* does cause one to question whether psychologically oriented decision researchers are too quick to use *homo economicus* as a straw man. For instance, Thaler and Sunstein (2008) describe the “idea of *homo economicus*, or economic man” as “the notion that each of us thinks and chooses unfailingly well”, and that this is the “textbook picture of human beings offered by economists” (p. 7). We should ask: precisely, which economists have offered us this picture, when and how did they do so, and to what ends? As we have seen, this was certainly not the picture of the entrepreneur offered by Knight — even though he was content to make assumptions in the spirit of *homo economicus* in order to derive his theories of choice, price and profit. A reviewer pointed out that few of Knight's contemporaries held to a belief in omniscient rationality for their theories of economic choice. Clark (1918) noted that economic choices will depend on a host of individual differences (thereby acknowledging potential shortcomings in cognition), including the habits, suggestibility, and calculative ability of the individual, and how readily he can bring alternative course of action to mind. Keynes (1935) asserted that a large proportion of actions rely on “spontaneous optimism” rather than “mathematical expectation”, and that decisions are *rarely* the “weighted average of quantitative benefits multiplied by quantitative probabilities” (p. 161).

Third, reading Knight (1921) has re-emphasized for me that if ideas are “lost” or ignored, the accumulation of facts can be piecemeal, and the development and testing of theories can be slowed (Meehl, 1978). What I hope to have shown is how decision research in the late 20<sup>th</sup> century could have benefited from a close reading of Knight's *RU&P*, particularly as a source of useful hypotheses to pursue. Knight put forward many ideas that were not formally developed, incorporated into theoretical frameworks, or assessed until many decades later. Progress might have been quicker if the ideas of

Knight had been more widely known among psychologists. It may not be essential for today's decision psychologists to plunder the back catalogue of economic classics. Though, as Knight was not alone in painting economics in strong psychological tones (e.g., Keynes, 1935; Marshall, 1890), there may be some merit in re-examining Knight and his economic peers and predecessors. For example, Ashraf, et al. (2005) examined the early writing of the 18<sup>th</sup> century economist Adam Smith — identifying ideas that been pursued in behavioral decision theory, and others which remain unexploited. The point is: we should be open to the possibility that the best sources for “fresh” ideas may lay outside the confines of our own discipline, or may be found in literature much older than we typically examine. Decision psychologists have been keen to emphasise that their theories and insights have important implications for economic theory. A reading of Knight's *Risk Uncertainty and Profit* emphasises that important psychological insights may manifest themselves in the writing of those who do not describe themselves as psychologists.

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## Comment: This is not how science is done.

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It will be interesting to the readers of *Judgment and Decision Making* that Knight (more or less clearly) knew so much in 1921. However, I think that the assertion in the last paragraph that: “What I hope to have shown is how decision research in the late 20<sup>th</sup> century could have benefited from a close reading of Knight's *RU&P*, particularly as a source of useful hypotheses to pursue” makes no sense at all. This is not how science is done.

Science is essentially a conversation in which people respond to what others have most recently said, or to the ideas that are currently dominant. Ideas that change the direction of the conversation are new because they are new in the conversation — not because no one has had them before. The exercise of finding that “new” ideas are similar to earlier ideas is profoundly affected by hindsight and typically (as in this case) ignores the conversational context. In our case we stumbled for years before we truly understood what we meant by our own work on heuristics and on prospect theory. Reading Knight would not have helped us at all — we would not have recognized that what he said meant the same thing as what we said, and indeed it did not (because what we said in prospect

theory was a reaction to the idea that utility is attached to final states, which was dominant in decision theory at that time, but had of course been asserted by Bernoulli in 1738).

I don't think many psychologists draw their hypotheses from Plato or Montaigne, though these authors certainly said many things that sound similar to ideas that people proudly publish in *Psychological Science*. Moreover, I very much doubt that familiarity with the classics really helps people develop "new" hypotheses. Amos and I often noted that our grandmothers knew most of what we discovered and published — which does not imply that we would have done better work if we had listened to them more attentively.

## Comment: Past work is one source of inspiration among many

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In some cases, historical scholarship has apparently influenced modern researchers in ways I think are beneficial. For example, Eleanor Rosch claimed to get her ideas about "family resemblance" from Wittgenstein. George Loewenstein was an avid reader of economics from the 19th and early 20th century, and he cites this work as an influence on at least his early work on intertemporal choice. Now it is possible that these scholarly references to this literature are post-hoc, but I doubt it. For what it is worth, I think that some of my own research has benefited from "importing" ideas of philosophers into psychology, particularly the work of Jonathon Bennett (on acts and omissions).

In other cases early work has been ignored and wheels have been re-invented. The invention of the very important distinction between normative and prescriptive models happened without any explicit reference to parallel ideas in the writing of J. S. Mill and Henry Sidgwick, or anything other than the immediate need. But, as Kahneman points out, those who invented this distinction might not have done it any faster if they had read these early philosophers.

Historical work can even be misleading. I think that "equity theory" got off on the wrong foot by taking some major ideas from Aristotle about what should count as fair allocation.

On the whole, I think that a lot of creative work is the result of the juxtaposition of views that do not often touch each other. This might have happened in Prospect Theory. One of its essential ideas, diminishing sensitivity, could have resulted from the juxtaposition of economics and psychophysics, which had been separate for many

decades. If I am right about this, then reading old books in another field is as legitimate (and as potentially misleading) a source of inspiration as opium-inspired pipe-dreams.

## Reply

I agree with Daniel Kahneman that developing hypotheses from dormant theories or older texts is not the standard operating procedure of science. Nonetheless, if you ask a room of researchers to generate some examples (as I did), most people can identify one or two good cases. Taken together, such cases point to the potential profit to be drawn from older sources.

For instance, not only did Eleanor Rosch draw upon the philosopher Wittgenstein, she also tested hypotheses from the psychologist Titchener [1909] in experiments on semantic categories (Rosch, 1975). In a similar vein, Daniel Gilbert expounds a wide variety of sources from different eras, and has tested one of Spinoza's [1677] propositions on the nature of mental representation (Gilbert, Krull, & Malone, 1990), and a previously untested element of Allport's [1954] ideas on cognitive economy and stereotypes (Gilbert & Hixon, 1991). This latter example illustrates how theories and ideas that are widely and frequently acknowledged may still have elements that are open to fresh exploration. For instance, Lerner's writing from the 1960s and 70s was the inspiration for a large literature on individual differences in beliefs in a just world. Nonetheless, work in the last decade has identified and tested "new" hypotheses from Lerner's writing (e.g., Callan et al., 2010; Hafer, 2000). Similarly, many ideas from the New Look theorists of the 1940s and 50s (e.g., Bruner) influenced perceptual psychology in subsequent decades — yet Balci and Dunning (2006) could still identify and test a hypothesis from this school (regarding the effect of motivational states on perception) which seemingly had been untested for some 50 years.

Knight and his fellow psychologically-oriented economists could perhaps be viewed in this light: as theorists who made a contribution to psychological decision theory (e.g., the risk-uncertainty distinction) but whose potential contribution may not have been fully exploited, and who may still have something to offer. When psychologists refer to William James, Charles Darwin, Jerome Bruner or Herbert Simon, it is generally out of respectful acknowledgment for their ideas, or as a useful means of framing the current conversation. However, as Jonathan Baron notes, sometimes the writing of such figures really can provide the inspiration for fresh hypotheses. The primary purpose of my article was to show that, within the field of behavioral decision making, Frank Knight is similarly worthy of respectful

acknowledgment. Moreover, acknowledgement aside, there may also be some elements in his work that can usefully be explored afresh.

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