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Consider the Source: An Examination of the Effects of Externally and Internally Generated Content on Memory

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Drawing on ideas from philosophy (in particular, epistemology), I argue that one of memory's most important functions is to provide its owner with knowledge of the physical world. This knowledge helps satisfy the organism's need to confer stability on an ever-changing reality so the objects in which it consists can be identified and reidentified. I then draw a distinction between sources of knowledge (i.e., from physical vs. subjective reality) and argue—based on evolutionary principles—that because memory was designed by natural selection to interface with the physical world, knowledge acquired via sensory/perceptual experiences should be better remembered than internally generated knowledge made available by introspection. A study conducted to test this hypothesis provides support. I conclude that a serious interdisciplinary approach to issues typically considered the purview of psychology best enables researchers to craft well-specified, theoretically based hypotheses that directly target functions of the mind.

Keywords: mind:subjective reality, memory, evolutionary biology

The central nervous system enables its owner to utilize the knowledge acquired within the organism's lifetime (i.e., ontogenetically) to prepare for contingencies that experience suggests probably will be encountered (e.g., Bar, 2011; Klein, 2013, Klein et al., 2002; Suddendorf & Corballis, 1997). Such knowledge clearly is an adaptive priority: Confronted with the changes and uncertainties that inevitably attend one's environment, flexible, adaptive strategies enhance an organism's survivability and hence reproductive success (e.g., Bar, 2011; Klein, 2013; Klein et al., 2002, 2010; Nairne, 2005; Suddendorf & Corballis, 1997; Suddendorf et al., 2009; Tulving, 2005).

Our knowledge of the world depends—wholly, or in combination with a priori principles (e.g., Eddington, 1958; Kant, 1998)—on our experience of the objects with which it is populated (e.g., Broad, 1925; Russell, 1913/1992, 1912/1999; Tallis, 2008). But, to serve as the basis for knowledge, an object must appear sufficiently consistent to permit its identification and reidentification (e.g., Brennan, 1988; Klein, 2019; Mead, 2002; Sider, 2001). We must be able to attribute properties (e.g., size, shape, mass, color, etc.) in virtue of which the object acquires its identity.

A Brief Note About the Word "Identity"

Since "identity" plays an important role in what follows, a few words about the concept are in order. In its most analytically rigid form, identity entails a numeric equivalence between the properties of (at least) two things. This "identity" typically is what we have in mind when we consider the term absent qualifying contextualization (personal identity, ethnic identity, gender identity, cultural identity, professional identity, multiple identities, and so forth). Identity, in its strictly numerical sense, is a property everything has as to itself and to nothing else. Formally, it is expressed as "X is the same as Y if and only if every property or characteristic true of X is true of Y as well." Historically, this is referred to as

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Leibniz's law (the principle of the indiscernibility of identicals; e.g., Black, 1952; Noonan, 1989; T. Williams, 2002).

Despite its inherent circularity—that is, numerical identity necessarily is true if and only if what is "true of X" is taken to include "being identical with X"—it remains the foundational expression of the concept of strict identity (e.g., Black, 1952; Brennan, 1988; Gallios, 1998; Oderberg, 1993). Interest in numerical identity primarily is found in philosophical treatments and mathematical analyses, and will not be discussed herein.

My focus, instead, will be on the identity of entities that undergo changes wrought by the passage of time. A stone, for example, can endure erosion or supplementation (e.g., by mineral seepage), yet still, be judged the "same" stone; a person can be considered the "same" person despite alterations in physical characteristics and mental states. This is the type of identity of interest to physical and social scientists (e.g., Klein, 2014a; Noonan, 1989; Shoemaker & Swinburne, 1984).

Accordingly, identity, construed as numerically exhaustive, has little theoretic or empirical traction in the physical and social sciences. Instead, less restrictive criteria are employed to explore "identity despite property variance" (what I call "sameness"; Klein, 2014a). Questions about "sameness" (e.g., "that appears to be the same car I saw yesterday," "on closer analysis, the two theories are the same," "I think we are working toward the same goal") allow that X can be the same thing on different occasions—or that X and X* can be the "same" despite occupying different spatial locations—even if the requirements for numerical equivalence are not met (e.g., Brennan, 1988; Oderberg, 1993; Wiggins, 1967/1971; C. F. J. Williams, 1990; T. Williams, 2002).

Unfortunately, the criteria used to establish "sameness" differ from one discipline to another (e.g., Brennan, 1988; Gallios, 1998; Oderberg, 1993; C. F. J. Williams, 1990). More problematic are questions concerning operationalization (e.g., Brennan, 1988; Butler, 1736/1819; Noonan, 1989). How are degrees of "sameness" to be measured; how are we to choose the degree of "sameness" necessary to designate entities the "same," and so forth? To date, attempts to establish such criteria appear highly arbitrary (for discussion, see Shoemaker & Swinburne, 1984; Wiggins, 1967/1971; T. Williams, 2002). The most one can say is that they are not exclusively numeric.

The Importance of Identity for Survival

"Human experience is experience of change" (Shoemaker & Swinburne, 1984, p. 42)

Sentient beings—in consequence of compositional changes objects undergo over time and the multiplicity of contexts in which and perspectives from which they are encountered—continually are bathed in flux.[1] Such flux creates serious problems for creatures whose viability depends, in large part, on the capacity to acquire knowledge of their world. It is difficult to know how to act toward an object or entity when the assignment of individuating properties is undermined by constant modifications resulting from componential, contextual, and perspectival variation (e.g., Brennan, 1988; Klein, 2019; Noonan, 1989; T. Williams, 2002).

Put differently, a sentient being's ability to know about and engage with objects (animate and inanimate) in its environment is a direct function of the object's expectedness. Forming expectations requires that what we observe does not change—or changes very slowly. Only when an object consistently appears as we expect it to appear and does what we expect it to do can it become a knowable aspect of reality (e.g., Klein, 2019; Spencer Brown, 1957).

Thus, expectedness is inversely related to the rate of change (physical or perspectival). If something—the tree we rely on as a landmark, the person with whom we interact regularly, the star whose nightly position enables us to chart our

[1] The thesis that "all things are in flux" can be traced to Pre-Socratic Greek antiquity (cf. late 6th or early 5th century BCE; e.g., Cornford, 1941, 1957; Kirk et al., 1983). The protagonists divide into two camps (which continue to shape the Western debate about the nature of reality; e.g., Papa-Grimaldi, 1998; Toulman & Goodfield, 1965) distinguished primarily by their metaphysical commitments—that is, those who posit change as the *nature* of reality, and those who regard change as the *appearance* (i.e., experience) of an unchanging reality that lays behind it. It is important to recognize that despite differences in assignment of ontological status, both camps accord change a central role in the *physical* world (the *appearance* of change, after all, is an experience, and experiences are happenings realized in a subcategory of physical reality—i.e., the brains of sentient creatures). Interestingly, a fundamental tenet of Buddhism is the doctrine of impermanence—the idea that all things, without exception, undergo continual change (e.g., Albahari, 2006; Harvey, 2012; Siderits, 2019).

course—changes too rapidly, greatly, or often, we find it difficult to develop expectations. In consequence, the object's status as an identifiable part of the perceptible world is compromised.

For example, if a tree changed its size, shape, color, physical characteristics, and so forth each time we encountered it, we would be unable to identify it. In the absence of such knowledge, we would find it hard to formulate expectations (e.g., "If I turn left at the oak tree I soon will come to the river"). Our ability to imbue the appearance of stability on objects undergoing continual change allows us to acquire knowledge of what they are, how they are predisposed to behave, and how we should behave toward them.

In short, to permit identification, an object's experienced presentation must be (reasonably) constant. But, given the inevitability of compositional change and perspectival variability, the sameness required for the formation of knowledge presents a challenge to sentient beings. What is needed is a means of stabilizing the objects populating the physical world.

Nature's Answer to the Problem of Knowledge: Evolutionary Biology and Memory

Why Evolutionary Biology?

Before proceeding, a few words are worth mentioning in support of my adoption of an evolutionary perspective on questions concerning knowledge and memory.[2] Researchers who apply evolutionary principles to psychological problems should welcome the integration of modern evolutionary biology into psychology because, outside of the operation of natural selection on our ancestors, there is no rational reason the brain should include any functionally organized elements beyond what random processes would produce (e.g., Barkow et al., 1992; Cosmides & Tooby, 1987; Klein et al., 2002; G. C. Williams, 1966).

One of the benefits of injecting evolutionary biology into psychology is a more stringent, rigorous set of criteria for understanding the origins and nature of functional organization in biological systems such as the brain. Biologists recognize that all functional organization ultimately is present because of the operation of natural selection (e.g., Dawkins, 1982, 1986). Selection constructs proximate machinery whose operation then may interact with the environment ontogenetically to construct an individual-specific organization, such as a skill, many of whose details were not prespecified by selection (i.e., a by-product).

Absent natural selection, there would be no well-engineered proximate machinery to respond to the environmental structure by orchestrating the construction of the functional organization. For this reason, every time a psychologist makes a functionalist argument, she/he is (knowingly or unknowingly) making an evolutionary argument. To improve the quality of functionalist reasoning in psychology, it is better to recognize that functionalism is evolutionary functionality, and to explicitly ground functionalist arguments in the only body of knowledge that makes them legitimate.

For these reasons, in this article, I apply the logic of adaptationism—that is, the evolutionary principles used to distinguish functional organization from the by-products of function and from noise introduced into designs by the stochastic components of evolution (e.g., Cosmides & Tooby, 1987; Klein et al., 2002; Mayr, 1983; G. C. Williams, 1966)—to the study of knowledge and long-term memory. From an adaptationist perspective, the brain is considered an organic machine designed by natural selection to use the knowledge acquired in an organism's past to coordinate its behavior in the present and future (e.g., Barkow et al., 1992; Klein, 2007, 2013; Klein et al., 2002; Mayr, 1983; Nairne, 2005; Sherry & Schacter, 1987).

[2] Virtually all academics take the words to *remember* and *memory* to be synonyms (Klein, 2018). In this article, I use the two terms interchangeably. However, I do so for expositional ease rather than theoretical commitment (simply put, I want to my arguments considered without the risk of them being swallowed by a debate over terminology). In contrast to the received view, I draw a sharp distinction between remembering and memory: Remembering is the process by which stored content is made available to consciousness. Memory is only one of many potential products of remembering. What separates memory from other mental states (e.g., knowledge, belief, imagination) is that memory is accompanied by an immediate, nonanalytic feeling that my current mental state is coterminous with a state of affairs experienced in my past. Because little in the present article rides on this distinction, I will not rehearse my reasons for these claims. For those interested, my arguments can be found in Klein (2015b) or Klein (2018).

Evolution and the Brain

The human cognitive architecture exists in its present form because that arrangement solved recurrent problems faced by the organism in its evolutionary past (e.g., Anderson, 1989, 1991; J. R. Anderson & Milson, 1989; Cosmides & Tooby, 1987; Klein et al., 2002; Sherry & Schacter, 1987). Evolution does not produce new, complex, metabolically costly phenotypic systems by chance (e.g., Dawkins, 1976; Klein et al., 2002; Mayr, 2001; G. C. Williams, 1966). Such systems acquire their functional organization because that specific design contributed to the organism's ability to survive and reproduce (e.g., Barkow et al., 1992; Klein et al., 2002; Mayr, 2001; Nairne, 2005; Sherry & Schacter, 1987; G. C. Williams, 1966). Over the course of evolution, modifications in the design of the human cognitive architecture were likely to be incorporated to the extent that they improved the functional operation of the architecture—that is, increased the rate that the architecture successfully solved adaptive information-processing problems (e.g., Cosmides & Tooby, 1987; Klein et al., 2002; Sherry & Schacter, 1987).

One way to study the functional design of a naturally selected system such as memory is to think of it as part of a machine, and then distinguish the machine's functions from its capabilities (e.g., Anderson, 1991; Cosmides & Tooby, 1992; Klein, 2014b; Klein et al., 2002; G. C. Williams, 1966). To specify a machine's function is to specify what it was designed to do.

Function Versus Capability

An example from Klein et al. (2002) helps clarify the distinction between function and capability. Imagine you are presented with a three-hole punch. Having never seen one, you are unsure what it is. Unbeknownst to you, it has been designed to serve a specific function—to put holes in writing paper so the paper can be stored in a three-ring binder. If you knew this, it would help you understand why its parts exist in their present form: Why the punch has elements sharp enough to cut paper, why there are exactly three of them, why they form a straight line, and so forth. These elements are design features—aspects of the machine that are there because they contribute to the successful performance of its function.

Yet every machine, in virtue of having a particular causal structure, is capable of doing an endless series of things it was *not designed* to do. As many children discover, if you shake a well-used three-hole punch, confetti comes out. The production of small circles of paper is a by-product of the machine's design: None of its parts exist because that arrangement makes confetti. Had the machine been designed to make confetti, one might expect more than just three elements, that their shape would be more in keeping with the festivities typically associated with the use of confetti (e.g., star-like rather than round), and so forth. In short, confetti-making does not explain the presence or arrangement of the punch's parts.

Nor do any of the punch's other capabilities—for example, its usefulness as a paperweight. These capabilities are arbitrary with respect to its intended function, by-products of the machine's design (e.g., Barkow et al., 1992; Klein et al., 2002; G. C. Williams, 1966). The tradition of studying memory by seeing what it is capable of doing—without asking what it was designed to do—is like studying a three-hole punch as if it were a confetti-maker or a paperweight. It is not an effective method for honing in on the set of highly ordered, interlocking elements that embody the system's functional design.[3]

An exclusive focus on capability tells us what memory *can do*, but it does little to help us understand what memory was designed *to do*. It is like studying the confetti produced by a three-hole punch. Absent a focus on the aspects of design directed by natural selection, we essentially end up studying the "confetti of memory."

Nature's Solution to the Identity Problem: A Functional Approach to Memory

A primary function of long-term memory (I would argue its evolutionary raison d'état) is its ability to transform the flux of the physical world into relatively stable mental representations. In doing so, evolution provides its answer to the problem of knowledge.

[3] A system's function(s) provides a privileged frame of reference: It is the only way of dividing a machine into parts that explains why those parts exist and take the form that they do. As a secondary matter, a functional description will, because it is causal, allow one to derive many of the system's other, nonfunctional capabilities as well.

In the early phase of organic evolution, sentient creatures had recourse to rudimentary mechanisms of stimulus stabilization (e.g., perceptual constancy, sensitization, stimulus generalization) to navigate the chaotic world of sensory variation (e.g., Eccles, 1989; Kaufman, 1974; Mostofsky, 1965; Walsh & Kulikowski, 1998; Young, 1976). Such mechanisms, being largely reflexive, were not able to support sustained, flexible, and tailored engagement with the environment (e.g., Klein, 2019; Klein et al., 2002).

Remembering helped solve this problem by supplying the appropriate neural systems with knowledge for use in coordinating responses to external contingencies. The primary mechanism by which this is accomplished is consolidation—that is, the progressive neural stabilization of ontogenetically acquired information, resulting in (comparatively) stable mental representations[4] (e.g., Dudai, 2004; McGaugh, 2000; Nadel & Moscovitch, 1997; Polster et al., 1991; Squire & Alvarez, 1995). By capturing the world of change in representational formats, the organism can *know about*—rather than simply be *influenced by*—its physical surroundings.

But a representational structure, no matter how stable or complex, is little more than a pointless appendage unless accompanied by mechanisms capable of making it available to the right systems at the right times. And, this is exactly what a system of remembering accomplishes (for discussion see, Klein et al., 2002). An organism cannot act "more appropriately"—that is, more adaptively—at a later time because of experiences at an earlier time unless it is equipped with rules that search for and deliver relevant, ontogenetically acquired information to the decision systems that guide behavior. In Klein et al. (2002), we referred to these mechanisms of memory as its "search and decision rules."[5]

Indeed, memory must have evolved its structure in response to the informational needs of the search and decision rules directing behavior. This is because memory properties that have no impact on an organism's behavior will not be visible to—and hence will not be shaped by—natural selection.

In sum, from the perspective of adaptationism, remembering can be viewed as the sentient organism's counterweight to physical reality's constant state of flux (e.g., Klein, 2019). In the next section, I draw on these ideas to formulate and test a novel prediction about the function versus the capacity of human memory.

An Empirical Demonstration

Externally and Internally Generated Memory Content

An important implication of the adaptationist approach concerns whether the content of memory originates from sensory experience or from internally generated cerebration. This is because, according to the logic of adaptationism, when memory is engaged in a manner that maximizes the expression of its evolved functionality, as opposed to ontogenetically acquired capabilities, it will be especially efficient (e.g., Barkow et al., 1992; Klein, 2014b; Klein et al., 2002, 2009, 2010; Nairne, 2005). Simply put, in most circumstances a machine performs optimally when it is tasked with doing what it was designed (by human hand or natural selection) to do.

In what follows, I will use the terms *external* and *internal* to designate whether the content provided to memory was culled from sensory/perceptual experiences or from self-generated mentation (a focus on the source of memorial content also is found in work on "Reality Monitoring"; for a comprehensive review, see M. K. Johnson & Raye, 1981).[6,7] Since this topic has received

[4] It is important to recognize that "stabilization," applied to experienced reality, is a relative term. More, remembered contents are not faithful transcriptions of the objects and events that gave rise to them; rather, they are approximate reconstructions that knit past experiences with current beliefs, motives, and even external suggestions. In short, remembering is constructive rather than reproductive, a foundational idea in memory research which traces to work by Münsterberg (1909) and Bartlett (1932).

[5] Since consideration of search and decision rules falls well outside the scope of this article, I direct the interested reader to Klein et al. (2002) for discussion. Here, I note that despite logical necessity, biological constraints (see above), and observational evidence (e.g., our daily reliance on for such rules for navigating reality), virtually nothing of theoretic substance is known about these mechanisms and their manner of operation (though attempts have been made: e.g., Hintzman, 1986; Kahana, 2020; Klein et al., 2002; Shiffrin & Raaijmakers, 1981).

[6] My terminology is decidedly *not* intended to designate two new forms of memory. As Tulving (2007) pointed out (with a sense of bemused incredulity), memory researchers show a marked proclivity to christen the outcome of each new task used in its investigation as heralding the discovery of a new type of memory (as of 2007, Tulving had identified more than 250 such "revelations"!). It is my contention that this runaway operationalism has done the field of memory no favors (e.g., Klein, 2015b, 2018; Rozeboom, 1965).

[7] Klein et al. (2002) used the terms *inceptive* and *derived* to label what I call *external* and *internal*. In this paper, I adopt the latter terminology since it seems better attuned to the distinction I am trying to capture.

limited consideration in memory research (e.g., Reality Monitoring),[8] a few words about the source of memory content seem in order.

Externally sourced content is compiled from sensory/perceptual processes directed at the external world. It consists of representations of the physical reality stored in ways that capture (to varying degrees; e.g., Bartlett, 1938) the manner in which they were encoded at their inception (i.e., the time at which they first were experienced).

Internally sourced memory content is generated from within the organism. Though typically derived from externally sourced content, internal content has undergone computational transformations (for discussion, see Klein et al., 2002) enabling it to supply material used in assembling the inner monologues and self-generated imagery that occupy a great part of our waking hours (thought, imagination, self-talk, judgments, plans, daydreams, and so forth). In contrast to the sensory/perceptual processes used to acquire external content, internal content is made available to memory exclusively via acts of introspection.

Since, by hypothesis, memory systems are adapted for interfacing with the physical world, memory for content acquired from the environment via sensory experience (i.e., memory's evolved function) should be superior to memory for content generated internally (i.e., a capability acquired ontogenetically in virtue of memory's causal structure).

The Hypothesis Under Consideration: Superior Memory for Content Acquired Through the Senses

The distinction between the source and origin (external vs. internal) of memorial content has largely been overlooked in the voluminous literature on learning and memory. However, it takes on an importance in light of our discussion of memory's evolved functionality.

Under many (most?) circumstances, remembering simultaneously makes available both types of content. It may, however, be possible to tease apart the contributions of each under appropriate experimental conditions. The experiment reported below is an initial attempt to affect an empirical dissociation between content derived from sensory/perceptual experiences with the external world and content generated internally by mental processes.

Participants received one of four versions of a questionnaire that varied both delays prior to recall—short (3 s) versus long (124 s; determination of interval lengths is explained in the Methods section, see below)—and the source of content to be recalled—external versus internal. The dependent measure was recall performance (success vs. failure)—that is, were participants able to remember the type of material requested (external vs. internal) as a function of delay preceding the recall attempt?

I predicted that in the Long Delay condition participants would be more likely to experience recall success when the content they were asked to remember was external than when it was internal. This is because the performance of a machine (e.g., memory) is best served when carrying out operations it was designed to perform.

I had no firm, theory-based prediction for the effect of content source on recall in the Short Delay condition. My expectation was that, given the brevity of delay (3 s), participants would perform well in both conditions (since the content requested was likely still in consciousness, readily available from short-term memory, or both).

The Experiment

Method

Participants. The participants were 100 undergraduate volunteers from an introductory psychology class. Participants were randomly

[8] The study of prospective memory (e.g., Kliegel et al., 2007) probably comes closest to examining memory for internally generated mentation. But this research does not specifically address (a) questions concerning the respective memorial properties and contributions of internally versus externally sourced content or (b) ground predictions on a well-specified set of theoretic principles carefully tailored to capture the functional tendencies of biologically designed organic systems (e.g., memory). In short, the examination of memory for internally sourced information was more an incidental by-product than the focal concern of that earlier work. Work on "Reality Monitoring" (e.g., Garrison et al., 2017; M. K. Johnson et al., 1988; M. K. Johnson & Raye, 1981) also shares a family resemblance to the work reported herein. It differs, however, in a fundamental way. While my concern is the manner in which content source affects memorability, Reality Monitoring focuses on identifying criteria we use to decide whether memorial content derives from internal or external sources.

assigned to one of 10 testing sessions, each consisting of 10 participants and lasting approximately 5 min. The same experimenter conducted all testing sessions. The study received approval from the University of California, Santa Barbara Human Subjects Committee.

Of the 100 participants volunteering, four failed to attend their assigned session. In addition, descriptions of memories provided by five participants indicated they failed to comply (either fully or in part) with instructions to tailor their recall to the experimental condition to which they were assigned (3 from the internal condition and 2 from the external condition). Therefore, a 11th session containing nine newly recruited participants was run to even the distribution of participants across the four experimental conditions. The participants whose data were included in the analyses reported below consisted of 39 males and 61 females.

Materials, Design, and Procedure. In each session, participants were provided with one of four versions of the test questionnaire. Each version represented one of four possible pairings of the two independent variables—Recall Delay (short or long) and Content Origin (external or internal). Distribution of the questionnaire was random, with the constraint that all combinations of independent variables be equally represented by the completion of the final test session.

Prior to the start of a session, participants gathered outside the door to the lab. When all participants had arrived, the experimenter announced loudly "Let's begin." Participants were asked to enter the lab and take a seat at a large table. They were allowed 90 s for this transition (pretesting showed this time was sufficient to allow comfortable passage from outside the lab to a seat at the table. Typically, most were seated in advance of the time allotted). A single-page questionnaire (face down) and a pen were placed at each of ten settings around the table.

At the start of the experiment, participants were read the following by the experimenter:

> Our memories can be based on information we acquire through our perceptions of the environment (for example, the things we see and hear taking place in the world) or on the information we acquire from looking inward on what is going on in our minds, rather than what is happening in our environment (for example, our inner self-talk, thoughts, imagination, daydreams). In short, we can remember the things we experienced in our surroundings or things taking place exclusively in our heads.

Reading this passage took approximately 31 s. Following this, participants were told to turn over the questionnaire in front of them and begin reading the instructions. Four versions of instructions were prepared.

In the Short Delay, External Source condition, task instructions read:

I want you to try to remember what you were perceiving (i.e., seeing, hearing, etc.) *just before I asked you to start reading this questionnaire*. Place an "X" next to the appropriate answer below. It is essential that you answer honestly and not guess what you might have been remembering. If you can remember—indicate so. If you cannot remember, indicate so. (Note: Bolding was used in the text to emphasize the temporal coordinates of the material to be remembered).

Pretesting indicated participants required approximately 3 s to read the first line of the instructions paragraph (i.e., the experimental manipulation of recall delay in the Short Delay condition).

Participants in the Long Delay, External Source condition read the same paragraph as those in the Short Delay version with one change. The phrase *just before I said* "Let's begin" was substituted for the phrase "just before I asked you to start reading this questionnaire." The time from entering the lab to reading the first line of the instructions paragraph took approximately 124 s. This established the interval in the Long Delay condition.

In the Short Delay, Internal Source condition, participant received the following instructions:

I want you to try to remember the self-talk taking place in your mind (i.e., what you were thinking about) *just before I asked you to start reading this questionnaire*. Place an "X" next to the appropriate answer below. It is essential that you answer honestly and not guess what you might have been remembering. If you can remember—indicate so. If you cannot remember, indicate so.

Finally, in the Long Delay, Internal Source condition, participants read the same material as in the previous condition with the phrase *just before I said* "Let's begin" in place of the phrase "just before I asked you to start reading this questionnaire."

The next section of the questionnaire asked participants to indicate, by placing an "X" in the appropriate box, whether they were "able to remember" or "unable to remember" the material requested by their questionnaire. If a participant checked the box "able to remember," she/he was instructed to "Use the lines below to provide a brief description of what you remembered."

Three minutes were allotted to complete the questionnaire (pretesting indicated this interval was sufficient for participants to read the instructions, make their ratings, and if necessary, write a description of what they remembered). After 3 min, questionnaires were collected and participants were debriefed.

Results

Chi-square analyses of recall performance (success, failure) as a function of Content Source (external, internal) were conducted for the Long and Short Delay conditions. In the Long Delay condition, participants asked to retrieve external content were more likely to report recall success than were participants in the Internal Content condition. Of the 25 participants in the External Content condition, 20 recalled their perceptual experiences after a delay of 124 s. In contrast, only 11 of 25 participants in the Internal Content condition were able to recall internally generated content (see Table 1, upper panel). These observations were confirmed by chi-square analysis: $\chi^2(1, N = 50) = 6.876, p = .0087, \phi = .37$ (where, ϕ is a measure of effect size for contingency tables, ϕ values between +.30 to +.39 indicate a moderate positive relationship between binary variables; e.g., J. Cohen, 1992).

Table 1
Recall Performance (Success, Failure) as a Function of Content Source (External, Internal) in the Long Delay Condition (124 s vs. 3 s)

Long Delay condition (124 s)		
	Recall performance	
Content source	Success	Failure
External	20	5
Internal	11	14
Short Delay condition (3 s)		
	Recall performance	
Content source	Success	Failure
External	21	4
Internal	23	2

Participants in the Brief Delay condition showed no statistically reliable difference in recall performance as a function content source (see panel 2): $\chi^2(1, N = 50) = .758, p = .385$, *ns.* As can be seen from Table 1, lower panel, regardless of source, participants showed comparable, high levels of recall success (21 of the 25 participants in the External condition and 23 of 25 participants in the Internal condition).

Given the exploratory nature of this experiment—which is as much a study of the feasibility of using empirical methods to examine internally generated memory content as it is a test of a specific adaptationist hypothesis—it seemed useful to look at how participants who reported recall success described the content of their recollections. Below are three randomly selected textual responses from participants who indicated successful recall in the External and Internal Content conditions as a function of Delay.

External Content, Short Delay.

1. I was looking at my watch and checking it with the clock on the wall.
2. Dudes to the left were talking and the girl to my immediate right seemed awkward.
3. I remember the design of the web page on my laptop screen (color, fonts, etc.). I also remember looking at items in my bag.

External Content, Long Delay.

1. I was listening to the chatter and snippets of peoples' conversations. Also remember smelling hand sanitizer.
2. I was checking the messages that my friend send me on my phone. I noticed a guy walking around and passing out papers.
3. I was looking at my schedule and going over what classes I was going to pick. I smell perfume.

Internal Content, Short Delay.

1. I was thinking about how I would like to read my book instead of going to class and also what work I have to do later and in what order I want to do them in.
2. I was thinking about an apartment I was trying to rent and then worrying my blue highlighter would mark my sweatshirt if the cap popped off.
3. If I should practice music, hang with my friends or go to LA a day early after class. Also, that I didn't remember that the exam is short answer and I probably will do really well.

Internal Content, Long Delay.

1. I was thinking this seems interesting and different from normal.
2. I feel like shit. OMG everything is incredibly annoying when I'm under the weather.
3. I was thinking about what I will be doing the rest of the night: What will I eat, when am I leaving, what am I wearing later.

While not much should be made of these reports (other than to note it clearly appears possible for people to separate memories for physical and mentally sourced experience), one additional thing stands out: Although delay did not play much part in the number of words used to describe externally sourced memories (both tend to be concise), it seemed to effect internally generated reports. Specifically, the transition from a short to a long delay appeared accompanied by a noticeable reduction in textual detail.

Since this observation is based on a sampling of a few randomly selected members from each of the four Content × Delay conditions, I decided to see if my impression held for the entire corpus of recollective reports. Statistical analyses revealed that, in keeping with my observations, participants recalling externally sourced content showed no reliable difference in the number of words used to describe recollections across levels of delay, *M*s = 15.76 and 16.45 words for the Short and Long Delay conditions, respectively: $t(39) = .367$, $p = .69$, *ns*. By contrast, participants in the Internal Content condition produced significantly longer recollections in the Short than in the Long Delay condition, *M*s = 25.61 and 15.55 words for the Short and Long Delay conditions, respectively: $t(32) = 2.69$, $p = .011$, $\eta^2 = 1.09$.

Discussion

Borrowing ideas from psychology, epistemology, and evolutionary biology, I argue that one of the most important functions of human memory is to provide its owner with knowledge recruited when reacting to current and imagined future circumstances (Klein, 2013). This knowledge is acquired ontogenetically from past engagements with the physical world and originates (in evolutionary time) from an organism's need to find stability in a fluctuating reality so the objects in which it consists can be identified and reidentified.

I then drew a distinction between the source of the content encoded (i.e., from external vs. internal reality) and argued—based on adaptationist principles—that because memory is designed to interface with the physical world, recall of content acquired via sensory/perceptual experiences should be superior to that for internally generated content made available to memory by introspection.

A study conducted to test this hypothesis lent support. Participants asked to remember after a long delay (124 s) were significantly more successful when the to-be-remembered material was externally sourced than when it was internally generated.

At a brief delay (3 s), there was no reliable difference in recall performance as a function of content source: Both conditions showed high levels of recollection. While this absence of an effect likely is due to the content targeted for recall being very recently acquired (and thus, still easily available in short-term memory; see, e.g., Cowan, 2008, for data on the duration of short-term and working memory), the fact that participants in both conditions were easily able to report memories shows that externally and internally sourced recollections are reportable provided their content still is available.

This observation received further support from an analysis of the length of recall reports. As mentioned, participants in the External condition showed no decrement in recall success as a function of delay. Paralleling this, they showed no decrement in the number of words used to describe recall as a function of delay. This can be interpreted as suggesting that their recollective abilities largely were unscathed by the delay intervals used in this study.

In contrast, participants in the Internal Content condition not only evidenced less recall success at a long delay—they also produced reliably less textual detail in their recall reports. That is, in addition to poorer recall at the long delay, their recall reports contained significantly fewer words than did reports from participants in the Short Delay condition.[9]

[9] While one can take issue with my interpretation—given that the textual detail in the Internal, Long Delay condition was comparable to that in the External, Long Delay condition—across content comparisons must be treated with extreme caution. Since there are no norms for textual detail by which to judge content reported from external and internal sources, it seems advisable to restrict analyses to within-content comparisons.

Limitations. One issue with the experiment reported is an apparent confound between Delay (long vs. short) and the context in which reporting occurred (outside vs. inside the lab). However, since theoretical predictions concerned *only* the effect of content source on *long-term memory* (i.e., the Long Delay condition), the context was constant (i.e., outside the lab) for both source conditions. Consistent with expectations, participants in the External Source condition were far more likely to report memory content than were participants in the Internal Source condition.

It is the case that the test context shifted (to inside the lab) in the Short Delay condition. However, as noted previously, I had no theory-based predictions for performance in this condition. It was included solely to demonstrate that participants can successfully access and report Externally or Internally sourced content provided this material is readily available (in consequence of still residing in consciousness or short-term memory; e.g., Cowan, 2008). In accordance with expectations, virtually all participants in the Short Delay condition reported memorial content relevant to their source condition.

It might seem that these obtained differences in memory potency as a function of content source have important implications beyond addressing the adaptationist-based hypothesis for which they were crafted. For example, considerations of source might suggest a number of pedagogical uses (e.g., teaching students how to study material in ways that optimize their retention; e.g., "Make sure to externalize your thoughts by speaking them aloud").

One must keep in mind, however, that the results and conclusions reported herein are not easily generalizable. There likely are conditions in which internally generated content is very well remembered despite significant delay (e.g., pondering a consequential decision concerning one's future, planning an upcoming event, thinking about an important person in one's life, etc.). All one legitimately can take away from the present results are that (a) under the conditions reported, it appears possible to empirically separate content source (for a similar conclusion, see M. K. Johnson & Raye, 1981) and (b) tests performed under these conditions produced results consistent with an adaptation-based hypothesis.

This is not to say that showing how properties of subjective reality vary as a function of content source is devoid of testable implications and extensions. For example, if my findings prove replicable and generalizable, they may help me understand the traditionally puzzling phenomenon of dream recall. It has been recognized since antiquity that dreams remembered on waking become notoriously difficult to recollect shortly thereafter (e.g., Calkins, 1893; D. B. Cohen, 1974; Foulkes, 1985; D. M. Johnson, 1979). Although research examining this phenomenon often has proposed that recall-fragility results from some, as yet unconfirmed, aspect of the dream work (see, e.g., Foulkes, 1985), the findings presented herein suggest a less mysterious possibility. It may be that dream memory shows more sensitivity to delay than many other types of memories simply because dream content is internally generated, and such content is especially vulnerable to the passage of time.

Thoughts and Implications. By taking an interdisciplinary approach to issues traditionally seen as falling within the purview of psychological analysis, it is possible to craft well-specified, theory-driven hypotheses that embrace the investigative mission (at least as I see it; e.g., Klein, 2015a, 2016) of psychological inquiry—that is., understanding the contributions of subjective reality to thought and behavior. Such an approach is essential (but likely not sufficient) if we are to make progress in understanding the difficult issues (i.e., the "hard problems" of psychology, such as consciousness; e.g., Chalmers, 1996; McGinn, 2004) that too often have been avoided by psychological research, or reduced to epiphenomenal detritus that can safely be replaced by materialist assumptions and questions (for discussion, see Klein, 2014c, 2015b, 2016).

The work reported herein suggests that jettisoning the subjective aspects of reality in favor of its more experimentally tractable physical constituents is a step that need not be taken. If we attempt to meet subjective reality head-on, the potential payoffs for the discipline of psychology (which ultimately is concerned with both the physical and subjective aspects of reality; see, e.g., Klein, 2016) may be enormous, shedding much-needed light on our understanding of reality in the fullness with which it is presented to experience.

References

Albahari, M. (2006). *Analytical Buddhism: The two-tiered illusion of self*. Palgrave Macmillan. https://doi.org/10.1057/9780230800540

Anderson, J. R. (1989). A rational analysis of human memory. In H. Roediger & F. Craik (Eds.), *Varieties of memory and consciousness: Essays in honour of Endel Tulving* (pp. 195–210). Erlbaum.

Anderson, J. R. (1991). Is human cognition adaptive? *Behavioral and Brain Sciences*, *14*(3), 471–517. https://doi.org/10.1017/S0140525X00070801

Anderson, J. R., & Milson, R. (1989). Human memory: An adaptive perspective. *Psychological Review*, *96*(4), 703–719. https://doi.org/10.1037/0033-295X.96.4.703

Bar, M. (2011). *Predictions in the brain: Using our past to generate a future*. Oxford University Press. https://doi.org/10.1093/acprof:Oso/9780195395518.001.0001

Barkow, J. H., Cosmides, L., & Tooby, J. (1992). *The adapted mind: Evolutionary psychology and the generation of culture*. Oxford University Press.

Bartlett, F. C. (1932). *Remembering*. Cambridge University Press.

Black, M. (1952). The identity of indiscernibles. *Mind*, *61*(242), 153–164. https://doi.org/10.1093/mind/LXI.242.153

Brennan, A. (1988). *Conditions of identity: A study in identity and survival*. Oxford University Press.

Broad, C. D. (1925). *The mind and its place in nature*. Kegan Paul, Trench, Trubner.

Butler, J. (1819). Of personal identity. In J. Angus (Ed.), *The analogy of religion* (pp. 211–215). Allman and Sawers. (Original work published 1736).

Calkins, M. W. (1893). Statistics of dreams. *The American Journal of Psychology*, *5*(3), 311–343. https://doi.org/10.2307/1410996

Chalmers, D. J. (1996). *The conscious mind: In search of a fundamental theory*. Oxford University Press.

Cohen, D. B. (1974). Toward a theory of dream recall. *Psychological Bulletin*, *81*(2), 138–154. https://doi.org/10.1037/h0037616

Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*(1), 155–159. https://doi.org/10.1037/0033-2909.112.1.155

Cornford, F. M. (1941). *The Republic of Plato*. Oxford University Press.

Cornford, F. M. (1957). *Plato and parmenides*. The Liberal Arts Press.

Cosmides, L., & Tooby, J. (1987). From evolution to behavior: Evolutionary psychology as the missing link. In J. Dupré (Ed.), *The latest on the best: Essays on evolution and optimality* (pp. 277–306). MIT Press.

Cosmides, L., & Tooby, J. (1992). Cognitive adaptations for social exchange. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (pp. 163–228). Oxford University Press.

Cowan, N. (2008). What are the differences between long-term, short-term, and working memory? *Progress in Brain Research*, *169*, 323–338. https://doi.org/10.1016/S0079-6123(07)00020-9

Dawkins, R. (1976). *The selfish gene*. Oxford University Press.

Dawkins, R. (1982). *The extended phenotype*. Freeman.

Dawkins, R. (1986). *The blind watchmaker*. Norton.

Dudai, Y. (2004). The neurobiology of consolidations, or, how stable is the engram? *Annual Review of Psychology*, *55*(1), 51–86. https://doi.org/10.1146/annurev.psych.55.090902.142050

Eccles, J. C. (1989). *Evolution of the brain: The creation of consciousness*. Routledge.

Eddington, A. (1958). *The philosophy of physical science*. The University of Michigan Press.

Foulkes, D. (1985). *Dreaming: A cognitive-phenomenological analysis*. Erlbaum.

Gallios, A. (1998). *Occasions of identity*. Oxford University Press.

Garrison, J. R., Bond, R., Gibbard, E., Johnson, M. K., & Simons, J. S. (2017). Monitoring what is real: The effects of modality and action on accuracy and type of reality monitoring error. *Cortex*, *87*, 108–117. https://doi.org/10.1016/j.cortex.2016.06.018

Harvey, P. (2012). *An introduction to Buddhism: Teachings, history and practices*. Cambridge University Press. https://doi.org/10.1017/CBO9781139050531

Hintzman, D. L. (1986). "Schema abstraction" in a multiple-trace memory model. *Psychological Review*, *93*(4), 411–428. https://doi.org/10.1037/0033-295X.93.4.411

Johnson, D. M. (1979). Forgetting dreams. *Philosophy*, *54*(209), 407–414. https://doi.org/10.1017/S003181910004883X

Johnson, M. K., Foley, M. A., Suengas, A. G., & Raye, C. L. (1988). Phenomenal characteristics of memories for perceived and imagined autobiographical events. *Journal of Experimental Psychology: General*, *117*(4), 371–376. https://doi.org/10.1037/0096-3445.117.4.371

Johnson, M. K., & Raye, C. L. (1981). Reality monitoring. *Psychological Review*, *88*(1), 67–85. https://doi.org/10.1037/0033-295X.88.1.67

Kahana, M. J. (2020). Computational models of memory search. *Annual Review of Psychology*, *71*(1), 107–138. https://doi.org/10.1146/annurev-psych-010418-103358

Kant, I. (1998). *The Cambridge edition of the works of Immanuel Kant; Critique of pure reason* (P. Guyer & A. W. Wood, Trans.). Cambridge University Press.

Kaufman, L. (1974). *Sight and mind*. Oxford University Press. https://doi.org/10.1097/00006324-197411000-00015

Kirk, G. S., Raven, J. E., & Schofield, M. (1983). *The presocratic philosophers* (2nd ed.). Cambridge

University Press. https://doi.org/10.1017/CBO9780511813375
Klein, S. B. (2007). Phylogeny and evolution: Implications for understanding the nature of a memory system. In H. L. Roediger, Y. Dudai, & S. Fitzgerald (Eds.), *Science of memory concepts* (pp. 377–381).
Klein, S. B. (2013). The complex act of projecting oneself into the future. *Wiley Interdisciplinary Reviews: Cognitive Science*, *4*(1), 63–79. https://doi.org/10.1002/wcs.1210
Klein, S. B. (2014a). Sameness and the self: Philosophical and psychological considerations. *Frontiers in Psychology*, *5*, Article 29. https://doi.org/10.3389/fpsyg.2014.00029
Klein, S. B. (2014b). Autonoesis and belief in a personal past: An evolutionary theory of episodic memory indices. *Review of Philosophy and Psychology*, *5*(3), 427–447. https://doi.org/10.1007/s13164-014-0181-8
Klein, S. B. (2014c). *The two selves: Their metaphysical commitments and functional independence*. Oxford University Press.
Klein, S. B. (2015a). A defense of experiential realism: The need to take phenomenological reality on its own terms in the study of the mind. *Psychology of Consciousness*, *2*(1), 41–56. https://doi.org/10.1037/cns0000036
Klein, S. B. (2015b). What memory is. *Wiley Interdisciplinary Reviews: Cognitive Science*, *6*(1), 1–38. https://doi.org/10.1002/wcs.1333
Klein, S. B. (2016). The unplanned obsolescence of psychological science and an argument for its revival. *Psychology of Consciousness*, *3*(4), 357–379. https://doi.org/10.1037/cns0000079
Klein, S. B. (2018). Remembering with and without memory: A theory of memory and aspects of mind that enable its experience. *Psychology of Consciousness*, *5*(2), 117–130. https://doi.org/10.1037/cns0000142
Klein, S. B. (2019). An essay on the ontological foundations and psychological realization of forgetting. *Psychology of Consciousness*, *6*(3), 292–305. https://doi.org/10.1037/cns0000197
Klein, S. B., Cosmides, L., Gangi, C. E., Jackson, B., Tooby, J., & Costabile, K. A. (2009). Evolution and episodic memory: An analysis and demonstration of a social function of episodic recollection. *Social Cognition*, *27*(2), 283–319. https://doi.org/10.1521/soco.2009.27.2.283
Klein, S. B., Cosmides, L., Tooby, J., & Chance, S. (2002). Decisions and the evolution of memory: Multiple systems, multiple functions. *Psychological Review*, *109*(2), 306–329. https://doi.org/10.1037/0033-295X.109.2.306
Klein, S. B., Robertson, T. E., & Delton, A. W. (2010). Facing the future: Memory as an evolved system for planning future acts. *Memory*, *38*(1), 13–22. https://doi.org/10.3758/MC.38.1.13
Kliegel, M., McDaniel, M. A., & Einstein, G. O. (2007). *Prospective memory: Cognitive, neuroscience, developmental, and applied perspectives*. Psychology Press. https://doi.org/10.4324/9780203809945
Mayr, E. (1983). How to carry out the adaptationist program. *American Naturalist*, *121*(3), 324–334. https://doi.org/10.1086/284064
Mayr, E. (2001). *What evolution is*. Basic Books.
McGaugh, J. L. (2000). Memory—A century of consolidation. *Science*, *287*(5451), 248–251. https://doi.org/10.1126/science.287.5451.248
McGinn, C. (2004). *Consciousness and its objects*. Oxford University Press. https://doi.org/10.1093/019926760X.001.0001
Mead, G. H. (2002). *The philosophy of the present*. Prometheus Books.
Mostofsky, D. J. (1965). *Stimulus generalization*. Stanford University Press.
Münsterberg, H. (1909). *On the witness stand: Essays on psychology and crime*. Doubleday.
Nadel, L., & Moscovitch, M. (1997). Memory consolidation, retrograde amnesia and the hippocampal complex. *Current Opinion in Neurobiology*, *7*(2), 217–227. https://doi.org/10.1016/S0959-4388(97)80010-4
Nairne, J. S. (2005). The functionalist agenda in memory research. In A. F. Healy (Ed.), *Experimental cognitive psychology and its applications: A Festschrift in honor of Lyle Bourne, Walter Kintsch and Thomas Landaur* (pp. 115–126). American Psychological Association. https://doi.org/10.1037/10895-009
Noonan, H. (1989). *Personal identity* (2nd ed.). Routledge.
Oderberg, D. S. (1993). *The metaphysics of identity*. St. Martin's Press. https://doi.org/10.1057/9780230377387
Papa-Grimaldi, A. (1998). *Time and reality*. Ashgate.
Polster, M. R., Nadel, L., & Schacter, D. L. (1991). Cognitive neuroscience analyses of memory: A historical perspective. *Journal of Cognitive Neuroscience*, *3*(2), 95–116. https://doi.org/10.1162/jocn.1991.3.2.95
Rozeboom, W. W. (1965). The concept of memory. *The Psychological Record*, *15*(3), 329–368. https://doi.org/10.1007/BF03393601
Russell, B. (1992). *Theory of knowledge*. Routledge. (Original work published 1913).
Russell, B. (1999). *The problems of philosophy*. Dover Publications. https://doi.org/10.2307/1400126 (Original work published 1912)
Sherry, D. F., & Schacter, D. L. (1987). The evolution of multiple memory systems. *Psychological Review*, *94*(4), 439–454. https://doi.org/10.1037/0033-295X.94.4.439
Shiffrin, R. M., & Raaijmakers, J. G. W. (1981). Search of associative memory. *Psychological*

Review, *88*(2), 93–134. https://doi.org/10.1037/0033-295X.88.2.93

Shoemaker, S., & Swinburne, R. (1984). *Personal Identity*. Basil Blackwell.

Sider, T. (2001). *Four-dimensionalism: An ontology of persistence and time*. Oxford University Press. https://doi.org/10.1093/019924443X.001.0001

Siderits, M. (2019). Buddha. In E. N. Zalta (Ed.), *The Stanford encyclopedia of philosophy archive*. https://plato.stanford.edu/archives/spr2019/entries/buddha/

Spencer Brown, G. (1957). *Probability and scientific inference*. Longmans.

Squire, L. R., & Alvarez, P. (1995). Retrograde amnesia and memory consolidation: A neurobiological perspective. *Current Opinion in Neurobiology*, *5*(2), 169–177. https://doi.org/10.1016/0959-4388(95)80023-9

Suddendorf, T., Addis, D. R., & Corballis, M. C. (2009). Mental time travel and the shaping of the human mind. *Philosophical Transactions of the Royal Society of London, Series B: Biological Sciences*, *364*(1521), 1317–1324. https://doi.org/10.1098/rstb.2008.0301

Suddendorf, T., & Corballis, M. C. (1997). Mental time travel and the evolution of the human mind. *Genetic, Social, and General Psychology Monographs*, *123*(2), 133–167.

Tallis, R. (2008). *The enduring significance of Parmenides: Unthinkable thought*. Continuum International Publishing Group.

Toulman, S., & Goodfield, J. (1965). *The discovery of time*. University of Chicago Press.

Tulving, E. (2005). Episodic memory and autonoesis: Uniquely human? In H. S. Terrace & J. Metcalfe (Eds.), *The missing link in cognition: Origins of self-reflective consciousness* (pp. 3–56). Oxford University Press. https://doi.org/10.1093/acprof:Oso/9780195161564.003.0001

Tulving, E. (2007). Are there 256 different kinds of memory? In J. S. Narine (Ed.), *The foundations of remembering: Essays in honor of Henry L. Roediger, III* (pp. 39–52). Psychology Press.

Walsh, V., & Kulikowski, J. (1998). *Perceptual constancy: Why things look as they do*. Cambridge University Press.

Wiggins, D. (1967/1971). *Identity and spatio-temporal continuity*. Basil Blackwell.

Williams, C. F. J. (1990). *What is Identity?* Oxford University Press.

Williams, G. C. (1966). *Adaptation and natural selection: A critique of some current evolutionary thought*. Princeton University Press.

Williams, T. (2002). Vagueness, identity and Leibniz' law. In P. Giaretta, A. Bottani, & M. Carrara (Eds.), *Individuals, essence and identity: Themes of analytic metaphysics*, (pp. 273–304). Kluwer.

Young, J. Z. (1976). *The evolution of memory*. Scientific Publications Division, Carolina Biological Supply Company.

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