

and causality with regard to past and future, and the bearing of such asymmetry on the uses and utility of retrospective versus prospective mental time travel, on which I comment.

Suddendorf & Corballis (S&C) propose that the capacity to mentally transport oneself into future situations imagined *in concreto* is a uniquely human cognitive adaptation that has not only played a decisive role in our evolutionary past but may also account for a large part of our current dominance on Earth. The case they make for this is, however, encumbered with difficulties, of which I will comment on a few largely conceptual matters.

Foresight – the ability to anticipate future needs and to act accordingly – is the key concept and source of utility in the authors' account. As they are well aware, foresight can be served by either direct semantic prospection or more round about mental time travel directed to the future. In fact, every single example illustrating foresight by means of mental time travel provided in the target article can be implemented by direct semantic prospection instead. But that means that those examples illustrate only the utility of foresight – which no one doubts – but not the specific utility of mental time travel for that purpose, as intended and implied by the authors. Thus, rehearsal for questions that may be posed in a forthcoming job interview (sect. 2.1) is readily accomplished through semantic prospection (“I wonder what questions I’ll get? Maybe this one...” etc.). What is more, S&C provide no concrete evidence that mental time travel *ever* yields information whose efficacy for success in planning for the future exceeds that provided by semantic prospection. Such information may in fact be unavailable in principle, for reasons connected with the nature of time and its relation to memory and imagination.

Occasional qualifications made in passing notwithstanding, the authors' entire argument is built upon a perfect symmetry between past and future, as strikingly illustrated in Figure 1 of the target article. Yet time itself, along with the causality of the macroscopic world, is profoundly and fundamentally asymmetric with respect to past and future. The past has actually happened, which means that it once was the present, and thus subject to memory storage by suitably equipped organisms (which is how it became “the past”). That means that in principle, at least, the possibility of veridical memory exists. There is no corresponding possibility with regard to the future, because the future has by definition not happened, being a mixture of coexisting latent possibilities as yet unresolved. Which of these is the “true future” cannot be known until it has “travelled to us,” and become the present. Similarly for causality: In the macroscopic world the effect follows the cause in time, but never the reverse. That is how the present (cause) becomes a memory (effect) by the next present along future-directed causal pathways.

It is the existence of a more or less veridical memory for the past which, on occasion, lends utility to revisiting that past in the imagination through mental time travel instead of relying on the distillate of that past provided by semantic memory. Let us say new circumstances have rendered a detail that did not seem important at the time relevant to our present concerns. Occasionally, we are in fact able to recover such detail by going back and “reliving,” as it were, the situation in question, though that utility is in all likelihood a rather marginal one. The veridical memory is the “destination” towards which we steer in retrospective mental time travel. There is no such destination for prospective mental time travel, because unlike the past, the future has not happened and all we can know is that *all* possible futures, except *one*, will in fact *not* materialize, but not *which* one.

That is, the great flexibility of future time travel which the authors tirelessly extol as its great advantage is to no avail as far as foresight is concerned, because the utility of anticipating the future for *prudential purposes* does not hinge on the number of imagined alternatives, but on being correct, and such prediction is possible only to the extent that the future is in fact foreseeable, which means being “like the present and the past” (see next paragraph). Moreover, nothing is less certain in that regard than

the fine grain (“particularities”) of imagined futures, the one additional advantage ascribed by S&C to actual mental time travel compared to semantic prospection. These points can be illustrated by the importance of *correctly* anticipating which questions will in fact be asked in a forthcoming job interview. Preparation for the wrong questions is wasted effort, and may even act as an impediment during the interview. Needless to say, mental time travel possesses no privileged power to pick the right questions.

What are we to make, then, of the striking parallels the authors array between past and future in human performance? In light of what has gone before, the answer is readily available. The only aspects of the future that are in fact predictable are those respects in which it continues to be like the past (at all time scales and in any number of attributes and statistical characteristics). When, therefore, we construe *possible* futures, they share vast domains of content with the present and its past states of variation vouchsafed by memory, whether semantic or episodic. In doing so, we are in fact in large measure projecting the past into the future, abstractly or concretely, and not “travelling” into it. The parallels listed by S&C follow as a matter of course.

To summarize: What the authors call mental time travel into the future is prospective fantasy and the use of imagery in scenario-building (for the latter in relation to the frontal lobes, see Nauta 1971). These have their uses, in various creative endeavors, say, endeavors which certainly may affect and change the future. That, however, is a matter of the extent to which those endeavors recruit workable causal channels for their implementation, and not of any special efficacy for actually anticipating the future on the part of the fantasies that inspire them, as the record of failed prospective fantasy supplied by human history reminds us.

Has mental time travel really affected human culture?

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Abstract: Suddendorf & Corballis (S&C) claim that mental time travel has significantly affected human cultural change. This echoes a common criticism of theories of Darwinian cultural evolution: that, whereas evolution is blind, culture is directed by people who can foresee and plan for future events. Here I argue that such a claim is premature, and more rigorous tests of S&C's claim are needed.

In the final section of their fascinating target article, Suddendorf & Corballis (S&C) propose that mental time travel has important implications for human culture: “Law, education, religion, and many other fundamental aspects of human culture are deeply dependant on our shared ability to reconstruct past and imagine future events” (sect. 6, para. 3). Yet, besides some informal speculation regarding stone tools and the use of fire (which, as the authors acknowledge, are “just-so stories”), the specific implications of mental time travel for human culture, and for research in the social sciences concerning cultural change, are left unexplored. It is important to distinguish between the *capacity* for culture and the *contents* of culture (Mesoudi et al. 2006). While mental time travel potentially has implications for both, I focus here on the latter, that is, the effect of mental time travel on changes in the contents of human culture, such as law, education, and religion.

The existence of mental time travel, specifically regarding future events (i.e., foresight), has direct relevance to an ongoing debate concerning the validity of the theory of Darwinian cultural

evolution. Recent years have seen a burgeoning interest in cultural evolution, the idea that human culture changes according to the same fundamental principles as do biological species, and that consequently many of the same tools, methods, theories, and concepts developed by evolutionary biologists can be adapted for use by cultural scientists to analyze cultural change (Aunger 2000; Henrich & McElreath 2003; Mesoudi et al. 2004; 2006; Richerson & Boyd 2005). Despite this growing movement, cultural evolution is still met with much hostility and opposition from many quarters, especially the social sciences most directly involved in the study of human culture, such as cultural anthropology and sociology. One of the most oft-cited criticisms of evolutionary approaches to human culture is that, whereas biological (gene-based) evolution is “blind” and undirected (Dawkins 1996), culture is directed by conscious and intentional human agents who can use their capacity for foresight to guide cultural change towards specific goals (e.g., Benton 2000; Bryant 2004; Carneiro 1985; Chater 2005; Dasgupta 2004; Hallpike 1986). For example, Benton (2000) criticizes Darwinian models of cultural change because “human agents act intentionally to produce anticipated outcomes: They are not ‘blind watch-makers’” (p. 216).

The initial reaction from advocates of Darwinian cultural evolution to such criticism was to deny that humans possessed foresight, and to argue that cultural change is just as blind as biological change (e.g., Campbell 1960; Rindos 1985; Simonton 1999). The existence of mental time travel, which, as S&C show, is supported by a rich body of evidence from neuropsychology and developmental, cognitive, and comparative psychology, appears to make this position untenable. Mental time travel allows people to simulate potential future scenarios in order to anticipate and plan for novel future events in a way that does not appear to have any parallel in biological evolution. Biologically evolved biases in learning can “predict” the future based on past regularities (Lorenz 1969; Mayr 1982), but biological evolution cannot actively simulate novel future events.

So does the existence of mental time travel invalidate the theory of Darwinian cultural evolution? Although it is possible, such a conclusion would be premature. First, it has yet to be established empirically that mental time travel has affected cultural change in a significant manner. This must be addressed not with just-so stories or vague talk of “intentional actors,” but by integrating the body of work from the behavioral and psychological sciences reviewed by S&C with evidence from the social sciences regarding actual cultural change. Existing studies (e.g., Basalla 1988) suggest that foresight plays little role in directing technological change, although such studies are relatively informal and do not make the important theoretical distinctions that follow from the work reviewed by S&C, such as between “semantic foresight” (i.e., script-like expectancies generated by semantic memory) and “episodic foresight” (i.e., forward-looking mental time travel). Future studies might simulate cultural change in computer-generated agents (Epstein & Axtell 1996) who possess varying degrees of foresight, from “no foresight” to “semantic foresight” to “episodic foresight” to “omniscience,” along a “continuum of mindfulness” (Dennett & McKay 2006), and match the resulting cultural dynamics to actual historical, archaeological and sociological data. Lab-based experimental simulations of cultural transmission and cultural evolution (Mesoudi 2007) might test the extent to which the episodic memory system is used to maintain complex cultural traditions, while ethnographers might quantify the long-term accuracy and consequences of episodic foresight in traditional societies.

Second, even if it *was* established that mental time travel has significantly affected cultural change, this does not automatically invalidate Darwinian approaches to culture. Even though people *can* simulate future scenarios, there is no guarantee that this simulation will be accurate. As S&C note, “Mental time travel is of course not to be mistaken for clairvoyance” (sect. 4.5). The well-documented inaccuracies in episodic memory (Loftus

1996; Loftus & Ketcham 1994) suggest that episodic foresight is similarly biased and inaccurate. Indeed, some of these biases have already been identified, such as the planning fallacy (Kahneman & Tversky 1979) or hyperbolic discounting (Kirby 1997). Critics of cultural evolution commonly conflate this imperfect “human foresight” with the perfect “supernatural foresight” of an omniscient being. Biology is blind in the latter sense, but so is culture: There is no omniscient being with perfectly accurate supernatural foresight guiding cultural change. Unfortunately, most critics of cultural evolution do not make this distinction, and assume that *any* kind of foresight automatically invalidates Darwinian cultural evolution. Cultural evolution does not have to be identical in every respect to biological evolution, and evolutionary models of culture have already successfully incorporated phenomena not found in biological evolution, such as blending inheritance (Boyd & Richerson 1985); perhaps the same can be done with mental time travel.

In summary, researchers who study culture would benefit from explicitly incorporating the theoretical distinctions identified by S&C into their work, while S&C’s proposal would benefit from a more detailed consideration of evidence from the social sciences regarding actual cultural change.

Developing past and future selves for time travel narratives

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Abstract: Mental time travel requires the sense of a past and future self, which is lacking in the early years of life. Research on the development of autobiographical memory and development of self sheds light on the difference between memory in other animals and its cultural narrative basis in humans.

Suddendorf & Corballis’s (S&C’s) claim that memory systems are adaptive for their contribution to future survival is consistent with Tulving’s (1983; 2005) arguments, and with my proposal for the evolution and development of memory (Nelson 1993a; 1993b; 2005). In considering the emergence of autobiographical memory in childhood, Nelson and Fivush (2004) proposed a constellation of contributions to this manifestation of time travel, similar to S&C’s proposal of a constellation of mechanisms responsible for foresight. We emphasized the development of representational language, conversational exchanges about past and future, and cultural practices, thereby placing more weight on the co-development of culture and biology in the emergence of episodic memory – and foresight – in both phylogeny and ontogeny than S&C do. The neglect of culture in mind in S&C’s account is in my view a serious drawback to their account of the uniqueness of the human ability to remember the past and foresee the future.

Prominent among the achievements Nelson and Fivush (2004) identified as necessary to autobiographical memory was skill in narrative construction and understanding and its use in personal memory recounts. Narrative is a unique cultural production, as universal in human societies as language itself. It provides the structural glue that ties together the who, what, where, when, and why that S&C recognize as necessary to complex foresight. But their theater metaphor strangely neglects the essential structure of narrative, the plot or drama that their “playwright” must produce. Instead, they imagine the playwright picking and choosing among pieces of prior specific episodic memories to make up a new scenario. But without the structure of a narrative, situated in a specific cultural setting, the play – the memory or