complexities that underlie our strivings for more elusive states such as happiness, or our achievements of long-term goals such as job stability and the like. One of the most adaptive features of future thinking in humans is that we can hold in mind a desire or goal state and work tirelessly to achieve it. Part of the reason that this is possible is precisely because we experience the motivating desire or goal *in the present*. For example, some instances of prospective memory rely on the ability to translate a current desire into a plan for the future. That is, my (current) desire to take my medicine at 7 p.m. (future) ensures that at 7 a.m., I place my medicine beside my drinking glass. Similarly, when a child or adult is able to delay gratification, the desire for the larger (or end) reward is present. Arguably, it is when we lose sight, or stop experiencing, these drives and emotions that we cease to work towards them in a future-directed manner. Thus, it is important to consider not only how the anticipation of a future state can drive behavior in the present, but also how a current desire can ensure that an action, which brings the organism closer to a future goal, is carried out.

Partial knowledge and development. Third, there is the issue of partial knowledge. Even by age 5, children have not developed all the components that S&C argue to be necessary for MTT. Are we to infer that prior to this age children are incapable of MTT? Although young children may not be able to consistently act in a manner that takes into account their future states, it seems overly conservative to argue that they are not capable of any form of MTT. True, some instances of MTT may require more advanced imaginative, executive, or theory of mind skills, but not all are required for a legitimate instance of MTT. For example, it seems plausible that a young child's inability to tell you what he's going to do tomorrow is not due to underdeveloped executive function skills but perhaps because of the division of labor in the family – mother does this planning. Careful developmental research would illuminate this and related issues. One could measure individual differences in executive function abilities and determine whether these predict individual children's performance on various MTT tasks.

Developmental science is crucial for constructing a more comprehensive theory of MTT. It will be important to develop tasks that not only test the child's ability to anticipate future states but also measure a number of other future-directed behaviors. In the early days of theory of mind research, a narrow fixation on children's understanding of false belief obscured the importance of many behaviors that form the foundation of a theory of mind, including joint attention, social referencing, and reasoning about desires and intentions. We should not make the same error again in the domain of future thinking.

The continuum of "looking forward," and paradoxical requirements from memory

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Moshe Bar

Martinos Center at Massachusetts General Hospital, Harvard Medical School, Charlestown, MA 02129.

bar@nmr.mgh.harvard.edu http://barlab.mgh.harvard.edu

Abstract: The claim that nonhuman animals lack foresight is common and intuitive. I propose an alternative whereby foresight is a gradual continuum in that it is present in animals to the extent that it is needed. A second aspect of this commentary points out that the requirements that the memory that mediates foresight be both specific yet flexible seem contradictory.

Two primary issues are emphasized in this commentary. One is my alternative proposal that foresight should not be considered an all-or-none phenomenon, as suggested, but rather as a continuum. Second, I argue that the requirements from the memory that mediates foresight seem contradictory: It has to encode specific experiences, while at the same time it should be flexible enough to be applied to new situations. Keeping both issues in mind as this field advances will help fine-tune the welcome contribution of Suddendorf & Corballis (S&C).

The claim that foresight is unique to humans is common, and is based on reasonable intuition, but there is no evidence to support it unequivocally. In fact, as S&C review, evidence suggests that nonhuman animals might actually possess some limited foresight. For example, scrub jays show planning ability with their food-caching behavior (Raby et al. 2007), fish can learn to anticipate feeding time and place (Reebs & Lague 2000), rats have shown successful anticipatory behavior in response to complex feeding schedule (Babb & Crystal 2006), and apes save tools for future use (Mulcahy & Call 2006). Although these demonstrations do not necessarily reflect foresight as complex as ours, they nevertheless reflect future-related thoughts and actions. Do these mechanisms differ on a qualitative level from human foresight? The evidence does not support a definite positive or negative answer to this question. Nevertheless, given how much more sophisticated and intelligent we are compared with other animals, intuition might dictate that animals are not able to think about the future, as suggested by S&C as well as by others. But foresight is not necessarily an all-or-none phenomenon. Therefore, rather than surrendering to intuition, I propose an alternative whereby foresight is a continuum in that it is present in animals to the extent that it is needed for survival in their own environments. Indeed, if a costly faculty such as foresight developed in humans for survival, it makes sense that nonhumans could benefit from it as well. Until definitive evidence to support the claim that nonhumans lack foresight is potentially reported, this alternative of a continuum is as plausible and thus should be assigned a comparable likelihood, which gives less weight to intuition, during treatments such as this presented by S&C. In other words, instead of providing complex explanations for behavior that is reminiscent of mental time travel in animals (e.g., "a combination of predispositions and specific learning algorithms"; target article, sect. 3.2, para. 2), we can follow the logic of Occam's razor and simply call it foresight of reduced magnitude.

That said, it is easy to see that animals would require foresight that is considerably less complex and rich in scenarios than that required by humans. Consider the range of activities in a life of a nonhuman animal, which is the "pool" of elements that can be combined to create a foresight. This pool includes sleeping, eating, grooming, mating, and usually not much more. In other words, no one but humans is expected to be able to imagine scenarios as complex as sipping a piña colada on the beach while checking e-mail on a laptop connected to the Internet via satellite. As reviewed in the target article, animals nevertheless show meaningful "precursors" of foresight ability. According to the alternative I proposed here, however, instead of a precursor, these manifestations may represent actual foresights, albeit of lower complexity. What might be seen as "limited ability for mental time travel" could indicate that animals have simply evolved as much of this ability as their environment and way of life require.

This issue of an all-or-none versus a continuum is analogous to another important issue. In the context of future-related processes, there is foresight that involves elaborate future-related thought, simulation and planning, and there are the simpler associations (e.g., fire = hot), which can be completely automatic and accomplished outside of awareness (Bar, in press). Are these two processes qualitatively different, relying on independent mechanisms, or do they reflect different extremes on a continuous spectrum of complexity? Although it is not clear if nonhuman animals possess foresight, it is clear that they can use simple predictions that are based on associations (i.e., they learn from experience and apply it in the future). Therefore, they might simply lack the presumably other mechanism required for elaborated foresight (Gilbert 2006). On the other hand, one could argue that while simple associations are merely atomic elements, when accumulated, they could serve the basis for phenomena as complex as foresight simulation (Bar et al. 2007). Let us consider a reasonably complex example: You need to get your friend a birthday gift. This does not sound like a simple associative operation. However, when we examine the constituent operations required to achieve this goal, it becomes apparent that experience-based associations may suffice: Your knowledge of this friend's taste as well as needs could be linked in an associative cluster (e.g., a context frame; Bar 2004); the items that correspond to this associative cluster (e.g., your friend likes but does not have an iPod, a vegetarian cookbook, a Toyota FJ Cruiser, 1980s memorabilia) are each associated in your memory with a certain price range and with knowledge of how to get each of these items, and they can be further linked with knowledge about your budget, time constraint, and so on. Therefore, a task that initially seemed quite remote from being based on associations, could be achieved by relying on associations and their appropriate integration. If foresight is indeed derived from associations of varying degree of complexity (which we might not always be aware of), this would support the proposal that foresight could be seen as a continual phenomenon of different levels of complexity and thus possibly present in animals, though to a lower degree than in humans.

The issue of associations is also related to the second part of this commentary. A critical characteristic required from the memory system that subserves foresight is flexibility. This is derived primarily from the notion that in creating foresights we frequently have to rely on past experience while modifying their details to adhere to novel situations. At the same time, it is widely endorsed, and presented logically by S&C, that episodic memory is the "database" from which foresights are drawn. Episodic memory encodes specific experiences (Tulving 1984; Squire & Zola 1998) using associative representations (Eichenbaum & Fortin 2005) and, as S&C review, contains the particularities of specific episodes (although episodic memory is far from being a perfect depiction of reality; see Schacter & Addis's commentary in this issue). That episodic memory is crucial for foresight is evident from reports of loss of foresight by patients with a compromised episodic memory, typically in medial-temporal amnesia (Klein et al. 2002b; Hassabis et al. 2007). What begs an explanation is how would a system that is so specific in its representation of relations can at the same time be flexible enough to be applied in novel situations. This paradox emphasizes that more work is needed before we understand the operations done on memory to derive foresight (Bar, in press). Addressing the computational and neural operations used for reconstructing and translating an existing memory into generalized future "memory" (Ingvar 1985) would result in knowledge with implications leading to important clinical, theoretical, and technological advances.

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Is mental time travel a frame-of-reference issue?

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Doris Bischof-Köhler and Norbert Bischof
Department of Psychology, University of Munich, D-80802 Munich, Germany.
bischof@psy.uni-muenchen.de http://www.bischof.com
bischof@psy.uni-muenchen.de http://www.bischof.com

Abstract: Mental time travel and theory of mind develop, both phylo- and ontogenetically, at the same stage. We argue that this synchrony is due to the emergence of a shared competence, namely, the ability to become aware of frames of reference.

As Suddendorf & Corballis (S&C) aptly point out, present evidence suggests that mental time travel is a specifically human phenomenon. This holds true, however, for other abilities as well, particularly theory of mind. This presents no problem for the contemporary "modularity" trend, as one can easily imagine any number of competences that are independent and domain-specific but emerge in phylogenetic synchrony, all the same, because they require cooperation in order to become functional. S&C appear to think along this line as well when they refer to theory of mind among the tools necessary for time travel, although they remain somewhat vague as to exactly how folk psychology contributes to a concept of time. Nonetheless, the assumption that time travel and theory of mind are outcomes of separate mechanisms poses the difficulty that their joint emergence occurs not only in phylogeny but in ontogeny, as well. We were able to show in a sample of 170 children that at around the fourth birthday a set of new competences synchronously develop. They include: a theory of mind as tested in a false-belief paradigm; time comprehension as demonstrated by predicting and comparing the running times of hourglasses; and the abilities to delay gratification, to temporally organize conflicting desires, and to anticipate future needs (Bischof-Köhler 2000). The correlation between these competences is age-independent. It would be difficult, in fact, to identify any vital necessity requiring their joint functioning at such an early age. All this suggests that these competences rest on a common mechanism.

We consider "frame-of-reference awareness" to be that mechanism. The term *frame of reference* was introduced by Gestalt theorists. Koffka (1935) thoroughly dealt with it under the label "framework" as distinguished from "things." If a feature of a thing is perceived as its absolute property, but is actually relative to its surrounding background, then the latter acts as a frame of reference for the former. Take size, for example. People in an Ames' room appear to grow or shrink when their position is shifted from one corner to the other. This effect is actually due to the background's geometry, but the observer, even if cognizant of the trick, is unable to perceive it this way. Gestaltists have primarily used the frame-of-reference concept to account for perceptual constancy phenomena. Koffka pointed out, though, that it can also be applied to social constructs like "civilization," and Lewin (1946) was among the first to extend it even further to motivational phenomena. Lewin stated that a toy might have a different emotional valence to a child depending on whether or not the mother is present, and explicitly compared this effect to the varying appearance of an object's size or color against different backgrounds. Following this line of thought, we may consider that motivation in general functions as a frame of reference that supplies a mood background organizing the valence profile of life space. Different things become salient, and the world takes on differing physiognomy for a subject when it is hungry, or alarmed, or in love.

Usually, frame-of-reference activity remains inconspicuous or, as Wolfgang Köhler put it, "silent." Only when contradicting frames overlap and cause experiential ambiguities, does one become aware of them. We postulate that the potential for this awareness is beyond the grasp of even the great apes and thus a core constituent of the human condition.

Mental time travel unquestionably requires the ability to reflect upon frames of reference. A shifting of temporal coordinates is necessary in order to conceive of a forthcoming event in the past tense by imagining it from an even further future perspective. Foresight as such, however, does not yet require