TEMPORAL UPDATING AND TEMPORAL REASONING

S. Sarimsoqov [1], N. Xolmirzayeva [2]

Abstract:
The dual systems approach to temporal cognition posits the existence of two distinct cognitive systems for processing information related to time. These systems are referred to as the temporal updating system and the temporal reasoning system. The temporal updating system is considered to be more primitive both in terms of evolutionary development (phylogenetically) and individual development (ontogenetically) compared to the temporal reasoning system.The temporal updating system is responsible for continuously updating and tracking changes over time. It handles real-time information processing and supports behaviors that require immediate temporal adjustments. This system is more instinctual and reactive, allowing for quick responses to temporal changes in the environment. On the other hand, the temporal reasoning system is more advanced and allows for higher-level cognitive processes related to time, such as planning, forecasting, and making decisions based on past, present, and future temporal information. This system enables individuals to engage in complex reasoning about time, including understanding causality, sequencing events, and predicting outcomes based on temporal patterns.

Key words: Temporal updating, temporal reasoning, phylogenetical, ontogenetical, foraging behaviour of hummingbirds, Mahr's perspectives on temporal reasoning.

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Human beings are able to think about the world they live in as being extended in specific points of time, and the ability to reason about causation and other temporal relations. This ability allows humans to understand and navigate the complexities of time, memory, and change in their environment. By incorporating temporal reasoning into their cognitive processes, humans can make sense of their past experiences, plan for the future, and adapt to changing circumstances. This rich temporal reasoning ability is a key aspect of human cognition that sets us apart from other species. Temporal reasoning involves an understanding of specific points in time, the ability to reason about causation and temporal relations, and the capacity to make sense of past experiences and plan for the future. On the other hand, temporal updating refers to a more basic form of cognition that lacks a temporal dimension and focuses solely on the present. While a creature with only temporal updating capabilities may not have a full understanding of time, it can still adapt its behavior based on new information and timing mechanisms. This distinction highlights the importance of temporal reasoning in human cognition and how it enables us to navigate the complexities of time and change in our environment.

In the context of foraging behavior, Pan and Carruthers ask how our account would explain the foraging behaviour in hummingbirds, temporal updating and temporal reasoning play important roles in understanding how these birds adapt their feeding strategies based on the rate at which flowers replenish nectar. Hummingbirds have been observed to be

[1] *Sarimsoqov Sirojiddin Shoyzoqovich, Teacher at Samarkand State Institute of Foreign Languages*
[2] *Xolmirzayeva Nargiza Onarboyevna, Master Student of Samarkand State Institute of Foreign Languages*

sensitive to the timing of flower replenishment, adjusting their foraging patterns accordingly. Temporal updating in this scenario would involve the hummingbirds' ability to track and remember the intervals at which they visit flowers and observe whether the nectar has been replenished. This basic form of cognition allows the birds to make real-time adjustments to their foraging behavior based on immediate feedback from their environment. On the other hand, temporal reasoning comes into play when considering how hummingbirds develop a more sophisticated understanding of the temporal patterns of flower replenishment over time. The idea of the birds possessing a "timer" that becomes entrained with the refresh rate of the flowers suggests a mechanism for temporal reasoning. By visiting flowers at different intervals and observing when they are full again, hummingbirds can infer and anticipate the optimal times to revisit specific flowers for maximum nectar intake. Overall, the combination of temporal updating and temporal reasoning enables hummingbirds to effectively exploit resources in their environment by strategically timing their foraging activities based on the dynamic nature of flower replenishment rates. This example illustrates how temporal cognition is crucial for animals to adapt and thrive in changing environments. The distinction, made by Pan and Carruthers, here is between the "mechanism question" and a more general "how does it happen" question. The mechanism question seeks to understand the underlying processes or mechanisms that explain a specific behavior or cognitive process, such as why a dog continues to believe a bone is buried in a specific location or how a hummingbird's timer becomes associated with representations of empty or full flowers. In the case of the dog digging for the bone, the mechanism question is answered by pointing to the persistence of beliefs over time as the explanation for why the dog still believes in the location of the buried bone. Similarly, in the case of hummingbirds, the mechanism question is addressed by explaining how specific states of a timer become associated with representations of empty or full flowers, influencing the bird's foraging behavior. On the other hand, the more general "how does it happen" question delves into the reasons behind why certain behaviors or cognitive processes occur. For example, in the case of the dog's belief in the location of the buried bone persisting, one could ask why this belief continues to influence the dog's behavior. This type of question goes beyond the specific mechanisms involved and explores the broader context and implications of the behavior. By distinguishing between these two types of questions, researchers can provide more nuanced explanations of cognitive processes and behaviors, considering both the underlying mechanisms and the broader reasons for why they occur. This distinction helps clarify different aspects of understanding complex phenomena in animal cognition. The sensitivity question, as you have aptly named it, delves into the relationship between the persistence conditions of beliefs or representations and the actual persistence conditions of the objects or events they are about. In the case of the dog's belief about the buried bone, this sensitivity question arises because the dog's belief is somehow sensitive to the persistence conditions of the bone itself. Similarly, in the case of the hummingbirds' behavior and their timer becoming associated with the refresh rate of flowers, the sensitivity question concerns how this entrainment process occurs and why the birds revisit the flower at different intervals after feeding. When considering explanations that involve beliefs or representations in animals' behavior, such as attributing to the dog a belief that buried bones tend to stay put or suggesting that hummingbirds have a representation of the time it takes for a flower to replenish, it becomes crucial to address how these beliefs or representations are formed and how they are sensitive to the persistence conditions of the objects or events they pertain to. In the case of the hummingbirds forming a representation of the time it takes for a flower to replenish, Pan and Carruthers propose that this representation is based on repeated visits to the flower at different intervals after feeding. This highlights the importance of understanding how animals acquire and update their beliefs or representations based on their interactions with their environment and how these mental states are influenced by the persistence conditions

of external events. By exploring the sensitivity question in animal cognition, researchers can gain deeper insights into the mechanisms underlying cognitive processes and behaviors, shedding light on how animals navigate and interact with their surroundings based on their mental representations and beliefs.

The idea that animals may not have a use for temporal reasoning about past events raises an interesting question about why this ability is significant for humans. Mahr's argument linking this question to the normative dimension of human interaction sheds light on the unique benefits of temporal reasoning in the psychological and social domains. Mahr suggests that the significance of temporal reasoning for humans goes beyond just preparing for the future. Instead, he argues that the ability to represent particular past events is valuable in itself, especially in understanding the normative dimensions of social interactions. For example, thinking about past interactions and events can help individuals grasp why certain social norms or obligations apply in a given situation.

In the example provided by Mahr, the ability to remember a promise made yesterday to meet at 5 p.m. today is crucial for understanding why someone might feel entitled to be annoyed if the promise is not kept. This illustrates how temporal reasoning about past events plays a key role in shaping our understanding of social norms, obligations, and expectations. Overall, Mahr's perspective highlights the nuanced ways in which temporal reasoning about past events contributes to human cognition and social interactions, emphasizing the importance of considering the normative dimensions of human behavior and relationships.

The ability to appreciate the pastness of events, as Mahr argues, is crucial for fully engaging with social obligations like promises. The temporal updating system alone may not be sufficient for understanding the implications of specific event occurrences within their contextual specificity. Ahr's emphasis on the importance of appreciating the pastness of events highlights a key aspect of temporal reasoning that goes beyond mere updating of information. In the case of promises, for example, understanding the temporal dimension of commitments involves not only committing to delivering on a promise but also acknowledging the future implications of failing to do so. This requires a more sophisticated understanding of time and events that the updating system may not provide. By focusing on the temporal reasoning system rather than just the updating system, Mahr's argument underscores the complexity of engaging with social norms and obligations that involve considerations of past events and their implications for future interactions. The analysis supports Mahr's claim that temporal reasoning plays a crucial role in navigating social interactions and understanding the consequences of our actions over time.

The connection between temporal reasoning and counterfactual thought extends beyond social obligations to encompass complex emotions such as regret. Regret involves appreciating the pastness of events and recognizing that there was a moment in time when different future outcomes could have unfolded but did not. This understanding of missed opportunities or alternative paths not taken is fundamental to the experience of regret. Beck and Rafetseder's discussion on the relationship between temporal reasoning and counterfactual thought highlights the importance of considering the temporal aspects of cognitive demands, especially in developmental research on counterfactual cognition. The suggestion that children's ability to engage in counterfactual thinking is closely linked to their understanding of time aligns with the idea that temporal reasoning plays a crucial role in processing counterfactual scenarios. The ability to think about locations in time independently from the events that occur in those locations, known as event-independent thought about time, is a key achievement associated with the emergence of the temporal reasoning system. Engaging in counterfactual thought about events in the past, such as the type of thinking that underlies regret, requires this event-independent perspective on time. McCormack and Hoerl's work emphasizes how counterfactual thought involves this kind of nuanced temporal cognition, where individuals consider alternative timelines and outcomes

separate from the actual events that occurred. Overall, the connection between temporal reasoning and counterfactual thought underscores the intertwined nature of cognitive processes involved in understanding the past, evaluating missed opportunities, and reflecting on alternative paths not taken. This interplay between temporal cognition and counterfactual thinking sheds light on how individuals navigate complex emotions like regret and make sense of their experiences within a temporal framework.

Conclusion

The distinction between the temporal updating system and the temporal reasoning system highlights the complexity of representing time and understanding how individuals process temporal information. While the temporal updating system may explain adaptive behaviors related to tracking changes over time, it does not necessarily provide a foundational way of representing the domain of times itself.

The representations of time that the temporal reasoning system operates with are not simply more explicit or enriched versions of those present in the temporal updating system. This suggests that time as a concept raises unique challenges when it comes to understanding how it is represented and how individuals develop the capacity to engage with temporal reasoning. The emergence of the capacity to represent time phylogenetically (across evolutionary history) and ontogenetically (in individual development) is a complex process that involves distinct cognitive mechanisms and systems. Understanding how individuals come to represent and reason about time involves exploring the interplay between different cognitive processes, such as memory, attention, and conceptual understanding, that contribute to our understanding of temporal concepts. Overall, the discussion underscores the nuanced nature of representing time and highlights the need to consider the specific cognitive mechanisms involved in temporal reasoning. By recognizing the distinct challenges posed by representing time, researchers can gain insights into how individuals navigate temporal information and develop an understanding of the complexities inherent in conceptualizing and reasoning about time.

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