

NESTED STRUCTURE OF TIME CONSCIOUSNESS AND ITS DEPENDENCE
ON MENTAL TIME TRAVEL COMPETENCE AND EPISODIC MEMORY

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ABSTRACT

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The main objective of this master thesis is to clarify the nested structure in time consciousness, depending on mental time travel and episodic memory. Time consciousness, mental time travel and episodic memory are connected, and function depending on each other. Mental time travel ability enables us to imagine personal future events. Episodic memory allows us to travel mentally into both past and future. Similarity between remembering the past and imagining the future indicates that episodic memory system contribute to future-directed personal mental time travel competence, and justifies the relation between episodic memory and mental time travel into both past and future. Episodic memory requires autothetic consciousness, which can be applied to mental time travel competence, and mental time travel is a function of episodic memory. Distinguishing humans and non-humans is a method to understand the role of episodic memory and mental time travel in time consciousness. Episodic memory and mental time travel indicate to a

higher-level time consciousness in humans, because mental time travel, episodic memory, auto-noetic consciousness and recursive language are unique to humans, while non-humans show future-directed acts, possess episodic-like memory, and communicate with limited ways. Time consciousness is derived from the notion of auto-noetic consciousness and it is a sort of temporal consciousness which enables us to be conscious of ourselves who travels in time and aware of ourselves along the temporal line. Non-humans have a rudimentary form of time consciousness, even they are deprived of auto-noetic consciousness.

Keywords: Time consciousness, Mental time travel, Episodic Memory, Auto-noetic Consciousness

ÖZ

ZAMAN BİLİNCİNİN YUVALANMIŞ YAPISI VE ONUN, ZİHİNSEL ZAMAN YOLCULUĞU YETENEĞİ VE EPİZODİK BELLEĞE BAĞLILIĞI

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Bu yüksek lisans tezinin amacı, zaman bilincinin, zihinsel zaman yolculuğu ve epizodik belleğe bağlı olan, yuvalanmış yapısını açıklamaktır. Zaman bilinci, zihinsel zaman yolculuğu ve epizodik bellek birbirleriyle ilişkilidir, ve birbirlerine bağlı olarak işlevlerini yerine getirir. Zihinsel zaman yolculuğu, kişisel gelecek olayları tahayyul etmemize olanak tanır. Epizodik bellek hem geçmişe hem geleceğe zihinsel olarak yolculuk etmemizi sağlar. Geçmiş hatırlama ve geleceği tahayyul etme arasındaki benzerlik, epizodik belleğin geleceğe yönelik kişisel zihinsel zaman yolculuğu kabiliyetine işaret eder, ve epizodik bellek ile geçmiş ve gelecek her ikisine doğru olan zaman yolculuğu arasındaki ilişkiyi doğrular. Epizodik bellek, zihinsel zaman yolculuğuna uygulanabilen, autoötic bilinci gerektirir, ve zihinsel zaman yolculuğu epizodik belleğin bir işlevidir. İnsan ve insan olmayan ayrımı, zaman bilincinde epizodik bellek ve zihinsel zaman yolculuğunun rolünü anlamak için bir methodur. Epizodik bellek ve zihinsel zaman yolculuğu, insanlardaki daha üst düzey bir zaman bilincine işaret eder, çünkü insan dışındakiler geleceğe yönelik eylemler gösterirken, epizodığe-benzer belleğe sahipken, ve kısıtlı yollarla iletişim kurarken; zihinsel zaman yolculuğu, epizodik bellek, autoötic bilinç ve

özyinelemeli dil insanlara özgüdür. Zaman bilinci, autothetic bilinç kavramından türer, ve zaman bilinci, zamanda yolculuk eden bizlerin, kendimizin bilincinde olmamızı, zamansal çizgide kendimizin farkında olmamızı sağlayan bir çeşit zamansal bilinçtir. İnsan dışındakiler, autothetic bilinçten yoksun olsalar bile, ilkel şekilde bir zaman bilincine sahiptirler.

Anahtar Kelimeler: Zaman bilinci, Zihinsel zaman yolculuğu, Epizodik bellek, Autothetic bilinç

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LIST OF ABBREVIATIONS

MTT	Mental Time Travel
EM	Episodic Memory

CHAPTER 1

INTRODUCTION

Time consciousness is a general feature of all animals and is found even in rudimentary forms in non-human animals. It provides us an inner perspective in temporal line. Metzinger states that “ego tunnel”, which I will explain in detail in Chapter 4, enables us to have inwardness in subjectively experienced temporal domain. (Metzinger, 2010) In this study, I aim to question the structure of time consciousness which is nested within (in other words, depending on) mental time travel, and episodic memory. The nested structure may refer to a hierarchical relation holding between mental time travel, episodic memory, and time consciousness. On the one hand, the idea of nested structure may also refer to the idea of fractal structure, and it becomes compatible with the recursive nature of mental time travel, which manifests that a temporal self that is recursively embedded in itself, comprise both his past selves and future selves.¹

¹ The notion of fractal and the “the simultaneity of nested Nows” underlies the theory of Vrobel’s fractal time. Her theory illuminates the subjective duration. A framework time is needed to explain subjective duration. However, before I look at Vrobel’s theory, I must explain what we refer when we use the term “fractal”. Mandelbrot introduced the term fractal in 1967. A fractal is a structure which is self-similar. The structure of the whole is similar to the parts of the whole. A recursive algorithm can provide us instructions to generate a self-similar fractal. (Vrobel, 2011, p.20) Seismic disturbances are good examples of temporal fractals. There is nested rythms in our bodies and minds, and dynamics in our bodies and our environment display self-similarity. Neural oscillations are embedded in metabolic rythms and they are examples of temporal fractals in nature. Our physiological and behavioral dynamics display fractal patterns. As an illustration to nested rythms, wake-sleep rhythm is a cycle of physiological and behavioral processes. Nested rythms form a fractal pattern in our bodies. Nested Now is also a nested fractal structure, as well as internal and external nested structures lead subjective duration to arise. (Vrobel, 2011, p. 31)

In Chapter 2, in order to understand how time consciousness, mental time travel and episodic memory are connected, I will appeal to functionalist analyses about these mechanisms and also evolutionary arguments about episodic memory and mental time travel in non-humans and humans. First, I will examine the relationship between episodic memory and the ability for mental time travel. For this, I start with the classification of various memory systems. Episodic memory can be defined as a mechanism which allows us to travel mentally into both past and the future. It is classified as a memory system in relation to time. On the one side, episodic memory is correlated with auto-noetic consciousness, which is an ability to be aware of subjective experiences in the past, present and future. (Tulving, 1985, 2001, 2002) Episodic memory presupposes auto-noetic consciousness and has a function in conscious awareness of past, present and future episodes. Since episodic memory is directed also towards future, mental time travel becomes functional by enabling us to simulate future-oriented personal episodes as a function of episodic memory.

It is generally agreed that remembering the past and imagining the future are related and, as Schacter et al. (2007) suggest, may be even a function of prospective brain. In relation to this, we can say that mental time travel ability may enable us to imagine personal future events. Memory impairments provide evidence for the tie between episodic memory and mental time travel. Patients who are deprived of episodic memory show also deficits in their mental travels into both past and the future. This is evident in deficiencies such as amnesia, depression, or schizophrenia. (Schacter et al., 2007; Suddendorf, 2010; Szpunar, Watson & McDermott, 2007; Szpunar, 2010; Markowitsch & Staniloiu, 2011) As said before episodic memory requires auto-noetic consciousness, and the deficit of episodic memory may have an impact on auto-noetic consciousness in those deficiencies. Remembering the past and imagining the future are the functional roles executed in episodic memory, and the neural overlap, which is the association of neural activation during remembering the past and imagining the future, also reveals that they are related. Similarities and differences between remembering the past and envisioning the future indicate that episodic memory system contributes to future-directed personal mental time travel

ability. In fact, Addis, Wong & Schacter (2007) argue that episodic future thought is an important function of episodic system. Since episodic memory enables us to do mental time travels into both past and the future, and presupposes auto-noetic consciousness, we should expect a connection between auto-noetic consciousness and mental time travel ability. There is some evidence for the similarity between imagining the future and remembering the past, which justifies the relationship between episodic memory and mental time travel into both past and the future.

In the third chapter, I concentrate on the roles of episodic memory and mental time travel in time consciousness. In order to explain their roles in humans, I make a distinction between humans and non-humans in their mental time travel and episodic memory abilities. Time consciousness enables us to be conscious of ourselves when we are mentally travelling to both past and future. Although non-humans display future-oriented acts, their behaviors are not as flexible as ours. (Suddendorf&Corballis, 2007) Humans are able to perform mental time travels, and they have episodic memory. Future planning grounded behaviors of non-humans demonstrate us that they have episodic-like memories. However, what non-humans do not possess is auto-noetic consciousness, which is the consciousness that enables us to be aware of personal past and future events and, according to Tulving (1985), is related to episodic memory. In the fourth chapter, I consider that mental time travel and episodic memory are unique to humans, and they indicate higher-degree time consciousness in humans. Mental time travel and episodic memory indicate a higher degree of time consciousness which avails us to be aware of ourselves along the temporal line by having auto-noetic consciousness, while non-humans have a different version of future planning skill nested in a lower level time consciousness with their episodic-like memory.² Organization of temporal representations as past, present and future takes time, and humans become experts in their awareness of time. Mental time travel capacity is a contribution of the unique, higher level time

² Human infants can capture the causal arrow of time after a critical age period, and they conceive the extension of self in time. (Povinelli, 2001)

consciousness in humans. While we construct future events, and reconstruct past episodes with our episodic memory (Corballis, 2011) non-humans do not possess episodic memory. So, the uniqueness of mental time travel ability and episodic memory in humans has an indicative role in time consciousness, which is agreed as a graded phenomenon.

I believe that consciousness includes a self which is embedded within itself on the basis of the idea of fractal time. We are temporal selves embedded in our recollection of past events and predictions of future events. Nestedness, which I use to express the relationship between time consciousness, mental time travel and episodic memory, can also refer to fractality, and this relatedness among these three items can be evaluated as an ability of humans who are extended in fractal time. Memory and anticipation converge in the Now, according to Husserl, what is now becomes immediately past, and events appear to us as future or past with respect to Now. Now has a nested structure in which past Nows are nested in future Nows. (Vrobel, 2011). Nested Now has a fractal structure, and we experience duration subjectively. Even though I will not concentrate on the fractal meaning of nestedness in this study, I mention some points tackled by some researchers because I did not want to disregard this side of nestedness.

The notion of nestedness which I appeal to describe the relationship between time consciousness, episodic memory and mental time travel ability in the way that mental time travel ability requires episodic memory which, in turn, requires (autonoetic) time consciousness. The roles that episodic memory and mental time travel ability play in time consciousness are related, and indicate to higher-degree time consciousness. Based on the ideas that autonoetic consciousness is a condition for episodic memory (Markowitsch & Staniloui, 2011), in other words, autonoetic consciousness is a dependent variable of episodic memory (Tulving, 1985), I suggest autonoetic consciousness can be applied to mental time travel ability, which is a function of episodic memory. Finally, it is possible to speculate that, if episodic memory requires autonoetic consciousness and mental time travel implies episodic memory, episodic memory and mental time travel indicate to a higher-level time

consciousness in humans (remembering that non-humans do not possess episodic memory, auto-noetic consciousness, recursive language and mental time travel ability). They do have “episodic-like memory”, and show future-directed behaviors, but their level of time consciousness is distinct from humans. The roles that the factors play in time consciousness, such as episodic memory, auto-noetic consciousness, and mental time travel are related to each other, and they are not found in non-humans. So, non-humans have a simpler form of inwardness in temporal line.

In section 4.3, in order to support my claim that recursive language and mental time travel indicate a unique version of time consciousness, I appeal to the idea that humans have a distinctive, recursive language faculty which enables them to convey infinite messages, while non-humans communicate with their limited ways. Corballis says that “recursive processes and structures can in principle extend without limit, but are limited in practice. Nevertheless recursion does give rise to the concept of infinity, itself perhaps limited to the human imagination.” (Corballis, 2011, p. 8) Corballis (2011) argues that recursive language and mental time travel might have evolved together. Recursion is an important character of human language, and mental time travel is one of the recursive functions of human mind, which is related to the evolution of language. (Corballis, 2011) Language is an outcome of the experience of time, and the ability of mental time travel. (Corballis, 2011) Humans differ from non-humans due to their level in subjective experience of time. Language also enriches development of episodic memory. (Tulving, 2005) Corballis examines that the role of recursion is an essential and unique property of human mind which allows us to make mental travels. It is virtually impossible to neglect the relation between mental time travel, episodic memory and time consciousness. Time consciousness is a graded mental attribute of minds. Furthermore, recursive mind, mental time travel and language are unique to humans, and these distinguish us from non-humans. It seems to me that recursive language and mental time travel indicate higher-degree time consciousness, because when those recursive mental attributes are not found, non-humans have a lower-level time

consciousness than humans. This study is an effort to understand and clarify the notion of time consciousness with the help of the notions, mental time travel, episodic memory and auto-noetic consciousness. I take into consideration the relationship between them and the claim that non-humans do not have them in order to understand how we have an inner perspective in temporal domain.

CHAPTER 2

DEFINITIONS OF MENTAL TIME TRAVEL AND EPISODIC MEMORY

In this part, I will briefly touch upon the definitions of mental time travel and episodic memory so as to understand the nested structure functioning in time consciousness, which depends on mental time travel and episodic memory. Definitions of mental time travel and episodic memory are crucial in explaining the subtle relationship between time consciousness, mental time travel, and episodic memory. I will show what these technical words such as mental time travel and episodic memory mean by giving their definitions and quick examples. In essence, mental time travel is a process involving mental mechanisms in the domain of subjective time perception. Mental time travel ability seems to require episodic memory, for episodic memory provides humans information from the past and it allows them to simulate future. (Suddendorf, Addis, & Corballis, 2009, p. 1317) Tulving described episodic memory as it stores information of what occurred where and when. This is www-criterion that shows what, where and when of events. On the other hand, Corballis and his colleagues argue that www-criterion is not sufficient for episodic memory. Although Tulving has changed his definition of episodic memory and states that auto-noetic awareness allows us to have episodic retrieval, Corballis insists that mental time travel is not fulfilling the www-criterion. (Ibid., p. 1320) Mental time travel capacity depends on imagining future scenarios; therefore, future orientation is crucial in having mental time travel capacity. What Hoerl tells about a particular kind of imagination exercise, might be a chief example for mental time travel. To illustrate, he wants his readers to suppose some people who are in a crowded restaurant for dinner. They ordered their meal and were waiting for their appetizers. While they were waiting, they saw a group who came earlier to the restaurant was eating their desserts. Hoerl distinguishes two kinds of

imaginative scenarios pertaining to this case. They may imagine that they were also eating their desserts like the group at the neighboring table, or they may think that they will eat their desserts in the future. Hoerl upholds that the latter case involves mental time travel, while the former type of imaginative exercise is travelling between possible worlds. (Hoerl, 2008, p. 495) In this thesis, I will not discuss what imagination is; I have just sketched out what kind of imagination exercise involves mental time travel ability, in order to be more explicit in defining mental time travel. A behavior is indicative of mental time travel when it has to be applied to the future. Children gain the ability to report events from the past and the future at around the age of 4 to 5, and whether people use similar cognitive resources in their mental travels into the future and the past might be an issue that needs to be dealt with distinguishing memory systems and the nature of episodic cognition. (Busby & Suddendorf, 2005, p. 369) Humans have mental time travel ability which allows them to transport themselves into their personal past or future. (Shanton & Goldman, 2010, p. 532)

2.1 Functional memory and mental time travel

Time consciousness, mental time travel, and episodic memory form a nested structure, each of which executes its role in this nested structure. In this part, I will briefly discuss the “nested” structure of time consciousness, depending on mental time travel and episodic memory. This analysis is amenable to interpretations of the notion, “nestedness” which I use to explain the relation between time-consciousness, episodic memory and mental time travel. The hierarchical roles that they play may prove of help for the task of clarifying how they form a nested structure. There might be several factors other than mental time travel and episodic memory functioning in time consciousness, but narrowing down the list is a way to understand how they contribute to time consciousness.

In this part, I will use a functionalist analysis of these nested mechanisms in order to understand how they are related to each other. In this functionalist analysis of memory and mental time travel, I will stress evolutionary arguments concerning humans and non-humans' ability of episodic memory and mental time travel. First, it is plausible to say that memory systems belong to one of three major strains – episodic memory, semantic memory, and procedural memory. It seems that mental time travel and episodic memory are tied together, and categorization of memory systems in terms of time is crucial to see the essential tie between mental time travel and episodic memory, because several notions may refer to the roles that they play. Knowing what episodic memory does differently from other memory systems will be a starting point to see the relatedness of episodic memory and mental time travel, and the function of episodic memory executes.

2.1.1 Classification of memory systems

Memory is divided into different systems and classified with respect to time. (Markowitsch & Staniloiu, 2011, p.18) Traditionally, episodic memory is accepted as a retrograde memory, however, nowadays it is no longer regarded as just a record-playing, and it also has an anterograde function in time-grounded categorization of memory systems. Markowitsch and Staniloui acknowledge that memory can be deconstructed along the time axis. Traditionally, memory is divided into short term and long term memory. Short term memory is limited in keeping information for a few minutes; while long term memory stores the information relatively permanent. “Working memory” which keeps information, not only time-limited information, but also retrieving stored information is also added to this time-related division of memory by Alan Baddeley. (Markowitsch&Staniloui, 2011,p. 18; Baddeley, 2000; Baddeley & Hitch, 1974) Markowitsch and Staniloui also unveil that distinction between old and new, anterograde and retrograde memories is another kind of division of memory with respect to time. Retrograde memory impairment refers to an

inability of accessing past information, while anterograde memory impairment corresponds to long-term acquirement of new information. (ibid., p.17) On the one hand, Tulving has content-based classification of long-term memory systems. He distinguishes these long term memory systems by distinct level of consciousness such as auto-noetic, noetic or anoetic, and auto-noetic consciousness is a condition for satisfying the requirement of episodic memory. (Markowitsch&Staniloui, 2011, p.19) Tulving takes measurement of different varieties of consciousness as a dependent variable. Procedural memory is characterized by anoetic consciousness, semantic memory is correlated with noetic consciousness, and episodic memory is related to auto-noetic consciousness. (Tulving, 1985, p. 3)

Anoetic consciousness is temporally and spatially bound to the current situation. Organisms possessing only anoetic consciousness are conscious in the sense that they are capable of perceptually registering, internally representing, and behaviorally responding to aspects of the present environment, both external and internal. Anoetic consciousness does not include any reference to non-present extra-organismic stimuli and states of the world. Semantic memory is characterized by noetic consciousness. Noetic consciousness allows an organism to be aware of, and to cognitively operate on, objects and events, in the absence of these objects and events. The organism can flexibly act upon such symbolic knowledge of the world. Entering information into, and retrieval of information from, semantic memory is accompanied by noetic consciousness. (Ibid., p. 3)

Tulving argues that episodic memory is traditionally defined as a mechanism that allows us to remember past events, but he proposes that episodic memory enables us to make mental travels. Tulving made a distinction between remembering and knowing. The distinction between conscious knowing and recollection corresponds respectively to the distinction between semantic memory and episodic memory. This distinction between remembering and knowing indicates that remembering involves recollective experience which is a kind of conscious experience; while there is no special kind of recollective experience in retrieval of information from semantic memory. (Hoerl, 2008, p.487) Tulving conducted an experiment to study retrieval

factors. Participants put an “R” for items they remember consciously, and a “K” for items they recall with respect to another basis. Subjects remember cued recall better than uncued recall. Tulving’s study is important for the separation of memory systems as procedural, semantic, and episodic which I mention at the beginning of this sub-section. According to Tulving’s conception, different sorts of conscious awareness are suitable for each memory system, and recollective experience belongs to the properties of episodic memory. Conscious recollection is a defining feature of episodic memory.

Autonoetic consciousness urges us to travel mentally in time. (Wheeler et al., 1997, p.331) Seeing that episodic memory requires autonoetic consciousness and autonoetic consciousness allows us to make mental travels in time, conscious future-oriented mental time travel is another feature of episodic memory. Future-directed mental time travels should not be disregarded, now that conscious recollection and conscious episodic future thought are comprised by episodic memory. As aforementioned, episodic memory, which allows us to make mental travels in time, presupposes autonoetic consciousness. Autonoetic consciousness has a function in conscious awareness of past, present and future events. Accordingly, mental time travel is a feature of episodic memory which enables us to make mental travels into the past and the future. Mental time travel has a function of simulating personal future episodes. Furthermore, envisioning future events and remembering past events are closely related and this settles how mental time travel and episodic memory are tied together. Further research will shed light on the functions of mental time travel and episodic memory, and functional considerations will open a fruitful avenue to understand how mental time travel, episodic memory and time consciousness are connected.

After distinguishing episodic memory from other memory systems, I now proceed with the function of episodic memory, and mental time travel. Episodic memory has a function in the survival through its intrinsic feature of mental time travel ability. (Markowitsch & Staniloui, 2011, p. 17) Memory is directed towards future due to adaptive necessity. (Bradley, 1887 ; Klein, 2013) In addition, Boyer

(2008) states that another function of mental time travel is to allow individuals to simulate specific personal episodes. Actually, it appears to be the primary function for the cognitive system. Social cooperation among humans brings benefits in the future, just as negative outcomes of omitting social cooperation are in the future. Moral attitudes yield us negative reward which deters us from opportunistic choices, because negative outcomes of opportunistic choices are time- discounted while their positive consequences are promptly culminated. (Boyer, 2008, p. 220) Humans engage in time-discounting which confers an adaptive advantage in terms of survival. Boyer says:

Time travel may be functional to the extent that it provides emotions that bypass current goals as well as time discounting, and therefore, provide us with immediate counter- rewards against opportunistic motivation. (Ibid., p. 222)

When the roles of mental time travel and episodic memory are evaluated, it seems broadly that they are related. Yet, functional look at mental time travel and episodic memory may elucidate the idea that remembering the past and imagining the future episodes overlap. To clarify, the conceptual consideration of episodic future thought that Szpunar (2010) suggests may be a stepping stone for us, because a large number of notions such as episodic future thought, simulation or projection, refer to imagining the future.

2.1.2 What does “Imagining the future” refer to?

What the notion of “imagining the future” refers to, is crucial in seeing how remembering the past and imagining the future are related, and holding a functional outlook at mental time travel and episodic memory. Szpunar aims to explicate what the notion of episodic future thought refers to, and he mentions murky points about

the ability of simulating hypothetical scenarios. A number of findings from recent studies reveal that episodic future thought and retrieval of past events are related. For instance, Schacter and his colleagues propose the concept of prospective brain. Remembering the past to predict and envision future events is an important function of the brain. (Schacter, D.L, Addis, D.R. & R.L. Buckner., 2007, p. 657)

Szpunar introduced the notion of episodic future thought and questioned other notions that are used to describe it. He prefers to refer to the ability of envisioning the future as episodic future thought which enables us to re-experience past events that might occur in the future. He differentiates episodic future thought from various “non-directed imagery”. As an illustration to this difference, according to Szpunar, imagining an elephant, imagining encountering an elephant on the way to school tomorrow, and imagining seeing an elephant during a trip to the zoo that anyone intends to visit next week are conceptually different cases. Mental time travel enables us to imagine personal future events, and remembering the past and imagining future episodes overlap, however, at first glance, to what imagining the future refers looks quite complicated. I have noted earlier that there are various notions, such as episodic future thought, simulation, or projection which refer to imagining the future. Though to what imagining the future refers is not explicit enough, up to this point. Therefore, I shall discuss what imagining the future means to some.

Shanton and Goldman recognize that re-experience of personal past events involves episodic memory, and pre-experience of personal future events involves prospection. (Shanton & Goldman, 2010, p.528) According to simulation accounts, imagination is a construction process which produces a pre-specified mental state in the self. Simulational mechanisms operate in projecting the self into the past which is called sometimes episodic memory; and projecting the self into the future which is referred as prospection. (Ibid, p. 532) It is pointed out that in mental time travel case, a person can flexibly recombine details from past episodes into a construction of either the personal past, or the personal future. (Ibid.) Imagining the future means a construction process, in which personal future episodes are constructed. Further, there might also be several imagination types. Imagination can be used to explain

various contexts, but what it really is, is not obvious. It has been assigned important roles in many activities, but different kinds of imagination explain different activities. (Kind, 2011) The notion of imagination might be heterogeneous and it has several dimensions. If imagination is distinguished from supposition, and imagination is discussed outside the context of simulationist treatment of imagining, it seems that someone should be more actively engaged with respect to imagining a scenario than she were supposing it. There are various treatments of imagination and imaginings do not have the same form, or structure. To illustrate, the simulationist treatment holds that imagination produces different kinds of states, such as belief-like or desire-like imaginings. (Kind, 2011, p. 7) In other words, imagination “is an operation or process capable of creating a wide variety of mental states. Imagination’s output, so understood is not a single type of state, but any one of a number of mental-state types” (Goldman, 2006, 47). The kind of imagining that explains our capacity of mind-reading may not be the same kind of imagining that explains justifications for our modal claims. The kind of mental activities to explain these different kinds of imaginings differ. Let’s have a look at the examples that Kind gives for mind-reading and modal epistemology.

3. Mindreading. Carole is playing the board game Settlers of Catan. In order to place her settlement in the most strategic location possible, she wants to determine what her opponent is likely to do on his next turn.

4. Modal epistemology. Sam plans to rearrange the furniture in his living room, but before he moves any of the very heavy pieces, he wants to determine whether it’s possible for the piano to fit where the couch currently is. (Kind, 2011, p. 2)

Imagination can explain how we predict mental states of others, and it also provides justification for our modal conclusions. These are some of the examples that Kind gives, but there might be further examples of activities in which imagination has been assigned important roles. Generally, it seems that we may not explain Sam’s decoration tips in terms of the same mental activity that explains Carole’s prediction

of her opponent's attack. Different kinds of imagination contribute to any attempt to account for the nature of imagination, but there might be a central capacity, or a common grounding in those imaginings. At least, imaginings may share a distinctive kind of representational content. We can give new samples of imagining that consists of similar contents.

2.1.3 Imagining the future as a function of memory

The function of episodic memory is to provide information flow for imagining future episodes, in the evolutionary sense. Episodic memory improves when it has a future-oriented function. The capacity for episodic future thought is an important function of episodic memory. Mental time travel allows individuals to imagine future episodes and consciously remember past happenings. A grasp of causal relations between events makes a certain kind of exercise of imagination a mental time travel situation. (Hoerl, 2008, p. 497)

If episodic future thought is described in terms of its dependence on episodic memory, auto-noetic consciousness, namely experiencing self, which enables us to travel mentally forward and backward in time is a force to be reckoned with, because episodic memory seems to presuppose auto-noetic consciousness. Episodic future thought enables thinking about events which may be related to our own futures. (Szpunar, 2010, p. 145) Auto-noetic consciousness which is the ability to "both mentally represent and become aware of subjective experiences in the past, present, and future" shows the relationship between episodic memory and the notion of episodic future thought. (Tulving, 2001, 2002)

Suddendorf emphasizes that episodic memory and episodic foresight are two sides of the same coin, regarding the capacity of mental time travel. Suddendorf's main concern is to see the role of memory in mental travels. Klein contends that future-directed information processing is important in understanding functional

groundings of human memory. (Klein, 2013, p.65). Episodic memory is likely to inform humans about future happenings, rather than a record play that only allows humans to go backwards in time. Since travelling mentally into both past and future are related, Suddendorf claims that this capacity's evolution is an important milestone in the evolution of humans. (Suddendorf, 2010, p.99) The claim that mental time travel is a unique capacity of humans focuses on whether non-human animals engage in mental time travel, or not. Observation of mental time travel in non-human animals may suggest indications of the relationship between future event imagining and remembering past episodes. Episodic memory might have evolved for its feature of mental time travel ability. Suddendorf argues that episodic foresight is an important milestone in human evolution. Memory has evolved for a million years, but the level of the capacity of foresight and prospection is debated. It seems that foresight is a survival strategy, thus episodic memory might have evolved for this reason. That is to say, humans display future-oriented behaviors and can travel mentally in time. In other words, they remember past episodes and imagine future episodes consciously. Mental time travel ability points to the relation between remembering past events and imagining future happenings. Thus, it is possible to claim that mental time travel ability and episodic memory which comprise future-directed thought are significant events in human evolution. Memory improves when it involves future-oriented goals. (Ibid., p. 104)

In addition, according to Markowitsch and Staniloiu, the level of the ability of self-awareness in different species is obscure, but Tulving has a clear answer for the extent of this higher level of self-awareness. Tulving proposes that humans have this unique capacity of auto-noetic episodic memory and mental time travel into the past and the future, and the relation between self and episodic memory is dynamic and close. (as cited in Markowitsch & Staniloiu, 2011, p. 23) Therefore, a functional evaluation of memory can help us to see the complex relation between episodic memory and foresight. Markowitsch and Staniloiu depict the strong relation between auto-noetic consciousness and episodic memory with a Venn diagram.

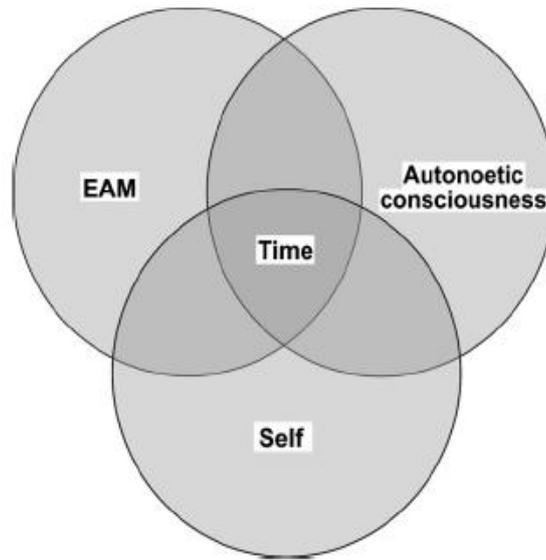


Figure 1. Connection between EAM, the self, and autooetic consciousness through embeddedness in time. (Markowitsch&Staniloui, 2011, p. 32)

The intimate relation, the overlap between autooetic consciousness, self and episodic-autobiographical memory can be handled from multiple aspects. Markowitsch and Staniloui point out the relation between self and episodic-autobiographical memory from a developmental perspective. They also remark the embeddedness of episodic memory in time. (Ibid., p. 25)

The autooetic “experiencing self” or the “rememberer” features the capacity to flexibly travel in mental time and space and a superior awareness of oneself as a person in a social (and biological) environment, with a past and a future. (Ibid., p. 24)

I think the diagram that I have used might give us a way to understand how autooetic consciousness and episodic memory are related with respect to time. This diagram shows us that episodic memory is accompanied by autooetic consciousness. Autooetic consciousness is a conscious re-experiencing past events. (Shanton & Goldman, 2010, p. 532) However, time intersects with autooetic consciousness, episodic memory and self in this diagram. The diagram has been

taken to refer to mental time travel into both past and the future; nevertheless it seems that Markowitsch and Staniloui depict the figure to demonstrate the remembering is accompanied by auto-noetic consciousness and self. If episodic memory also allows us to simulate future events, the shaded-area which time set represents looks obscure, because it consists of past, present and future events. It seems that episodic memory requires auto-noetic consciousness and auto-noetic consciousness operates well when applied to remembering past and imagining future events, which are instances of the functioning of episodic memory. EM might be a condition for future-oriented projections of personal mental time travel.³ A kind of imagining the future exercise which is executed by episodic memory is a mental time travel case. Imagining the future as a function of episodic memory reveals us that episodic memory is required to perform personal mental time travels into future. Episodic future thought and retrieval of past events are related, and are executed by episodic memory.

2.2 Auto-noetic Consciousness and Episodic Memory Impairments

Memory and auto-noetic consciousness impairments in psychiatric disorders can help us to understand the relationship between episodic memory and auto-noetic consciousness. Hence, in this section, I will cover dysfunctioning of episodic memory and auto-noetic consciousness in detail. Memory impairments also provide an insight into mental time travel. The essential tie between episodic memory and

³ Semantic memory may also contribute to mental time travels into the future, in many cases, semantic memory may be sufficient condition for future-oriented mental time travel as well. This might be due to that the classification of memory systems is not clear cut, or semantic memory may not be restricted by non-personal happenings, However, I shall not disregard the contribution of episodic memory in personal mental time travel imaginings.

mental time travel is constructed by elucidating the processes whose loss or absence prompt individuals to have memory impairments. In this part, I will concentrate on subjects who are deprived of episodic memory and show deficits in the sense of time. In diseases such as amnesia, depression or schizophrenia, patients may have disturbances in their mental travels into both past and the future. To illustrate, in Korsakoff's amnesia, the patient is deprived of episodic memory, and he cannot report about his personal past and future. This sort of deficit is also seen in psychiatric disorders. For example, the ability to remember past events, and imagine future autobiographical events is affected in depressed patients. (Schacter, D.L., Addis, D.R & R.L. Buckner, 2007, p. 657) In addition, imagining the future is affected in accordance with remembering the past according to recent neuro-imaging studies. According to fMRI results from individuals who response to event cues, prefrontal and medial temporal regions that are associated with specific past events are similarly reconciled with specific future events. There is no activation when participants imagine a specific event that involves a familiar individual such as Bill Clinton. Since Bill Clinton is known by most of us and he is easy to visualize. Task can be completed regardless of considering event's relation to time. (Szpunar, Watson & Mc Dermott, 2007, p. 646)

Patients with impairments of episodic memory have also lack of imagining future scenarios, because individuals represent themselves in time, in both directions by episodic memory. Amnesic patients are not able to remember their personal past and imagine future events. They do not have episodic memory. It may show us that they are deprived of auto-noetic consciousness. As Schacter quotes, amnesia is one of the cases in which patients have impairments in reporting past and future episodes. In psychiatric disorders such as depression or schizophrenia, mental travels into both past and future seem to be disturbed. (Suddendorf, 2010, p.100) Patients who suffer in reporting past and future directed events are diagnosed as amnesic and the lack of past and future thinking is consistent with the common neural overlap hypothesis. (Addis, Wong & Schacter, 2007, p.1363) Depressive patients or amnesics are not capable of representing themselves in future. (Szpunar, Watson & McDemmott,

2007, p. 642) Another study reveals that D.B. who has a brain damage cannot remember events in his personal past and imagine future scenarios in his personal future. Researchers conducted another study with D.B. about his ability of retrieval and simulation in impersonal manner. They found that D.B. could retrieve impersonal past and imagine impersonal future. Indeed, D.B. has an impairment of auto-noetic consciousness. (Szpunar, 2010, p. 144) Damages in neurological diseases show us disturbance of the sense of time, and patients have impairments in encoding and storing episodic memories. (Markowitsch & Staniloiu, 2011, p. 28)

Results from neuropsychological research with amnesic people and unimpaired participants also strengthen the functional distinction between episodic memory and other memory systems. Graf and Schacter make the distinction between explicit and implicit memory tests. Subjects could remember consciously past events in explicit memory tests, while they must not consciously retrieve them in implicit memory tests. Actually, memories observed in explicit and implicit memory tests differ. Two alternative conceptualizations of difference between explicit and implicit memory have been proposed. It is proposed that procedural and declarative memory differ. (Squire, 1982) The other conceptualization advocated is the difference between three memory systems: procedural, semantic and episodic. Therefore, neuropsychological results from amnesic patients support the distinction between memory systems, because amnesia disturbs some memory systems, while some memory systems remain intact and are not damaged. According to neuropsychological data, memory is impaired in a sort of processing, while other processing systems are not. Different sorts of processing are observed by different types of tests due to functional disassociation between explicit and implicit memory performance in healthy subjects. (Gardiner, 1988, p. 309) We can get the relation between episodic memory and time consciousness by appealing to episodic memory and auto-noetic consciousness impairments. Many auto-noetic consciousness and mental time travel capacity impairments co-occur with episodic memory impairments. (Markowitsch and Staniloiu, 2011, p.17) Indeed, the dysfunction convergence is due to episodic memory that requires auto-noetic consciousness. At

least, it shows that the nested relation is disturbed, depending on mental time travel and episodic memory impairments. It is expected to see a sort of dysfunctioning in time consciousness, due to time consciousness's nestedness to mental time travel and episodic memory.

2.3 Neural substrates of remembering past and imagining future episodes

Section 2.3 will stand for the idea that remembering the past and imagining the future may depend on a common memory system, and a neural overlap occurs during remembering the past, and envisioning future events. Remembering the past and constructing future events are roles executed in episodic memory and these roles can help us to see the relation between time consciousness and mental time travel. Thence, I will discuss that similar neural regions are active during remembering the past and imagining the future. Similarity between episodic memory and episodic foresight might be observed from empirical brain imaging data. Empirical data about neural underpinnings of *episodic future thought* may provide an insight into how retrieval of the past and envisioning the future is related, and what episodic memory and mental time travel's functions are. Physical underpinnings and processes which are instances of memory can be determined with respect to the roles that they play. There is a close neural overlap between activated neural regions when participants remember past events and simulate future happenings. It appears that both remembering the past and imagining future episodes are associated with a specific brain system.

The common memory system contributes to retrieving and simulating events. It seems that processes of remembering the past and simulating the future depend on a core brain system which involves similar neural underpinnings. Simulating personal future scenarios has rarely been subject to research by neuroscientists. Addis, Wong and Schacter examined (2007) conscious re-experiencing past happenings and pre-experiencing future events. They found left hippocampus is

active during construction of both past and future events. The neural overlap indicates that episodic system is promoting the simulation of future scenarios. (Ibid., p.1363) Autobiographical information involves essentially personal past and future events. Addis and his colleagues conducted an f MRI study to examine neural underpinnings of inherently episodic past and future happenings. They expected to find a common neural activation during event construction and elaboration. Results show that similar and distinct patterns of neural processes mediate past and future events, but they separate neural substrates with respect to event constructing and elaboration. Neural activity patterns associated with the construction, such as reconstruction of a past event or creation of a future event, and elaboration, such as retrieval or imagination of additional details, are examined. (Ibid., p. 1364) There is a striking neural overlap during elaboration phase while neural differentiation is more explicit during past and future event construction. There is more extensive activation during future event than past event construction. “In contrast to common past- future activity in the left hippocampus, the right hippocampus was differentially recruited by future event construction” (Ibid, p. 1372). Addis, Wong and Schacter conclude that common and distinct neural processes associated with past and future events. Neural substrates of past and future events differ during event construction phase, because future events recruit more regions in future-directed thinking. However, there is a strong overlap between past and future events in elaboration case. For example, in the left medial PFC, a common neural activity occurs. (Ibid., p. 1373) It appears that a common neural overlap of past and future events occurs during elaboration phase. This evidence yields insights into the adaptive functions of memory. (Schacter, D.L., Addis, D.R & R.L. Buckner, 2007, p. 659)

Szpunar and his colleagues claim that their findings are important to investigate the ability of envisioning the future. Their results offer neural substrates of episodic future thinking, and functional neuroimaging is used to identify particular regions which are active in envisioning the future. They report that many regions outside of the frontal lobes might be active during envisioning the future. There are similar regions activated when individuals simulate the future and retrieve the past.

These similar patterns of neural activation demonstrate how “autonoetic consciousness” is constructed. Tulving used this term to refer to a unique human ability of remembering the past and envisioning the future.

It is even conceivable that these regions could underlie a key process linked to autonoetic consciousness, namely the idea of mental time travel. That is, one core feature of autonoetic consciousness is the ability to take one’s conscious thoughts and project them forward or backward in time. (Szpunar, Watson and McDermott, 2007, p. 645)

Empirical data urge us to investigate the adaptive value of episodic system. Schacter points out the functional considerations are required to understand neural and cognitive processes in detail. It is remarkable that the functional role of episodic future thought allows us to see the relation between time consciousness and mental time travel. Even though the function of episodic system is accepted as remembering past events traditionally, its distinctive role might be future-oriented thinking. (Addis, Wong and Schacter, 2007, p. 1374)

Suddendorf says that a functional analysis of mental time travel can provide a fruitful insight into similarities and differences between episodic memory and episodic foresight. For instance, imagining the future is a crucial task for survival from an adaptationist point of view. Prospective brain uses memory system in order to simulate future scenarios. (Schacter, D.L., Addis, D.R & R.L. Buckner, 2007, p. 660) What is more, the proactive brain uses other abilities, such as using analogies and associations so as to generate future-oriented predictions. (Bar, 2007, p. 280) “Memory is used to generate predictions via associative activation” (ibid.) Associations yield the representational tool to generate predictions. Proactive brain extracts gist information and uses this information to form an analogy, matches input to similar representations in memory. (Ibid., p. 281) According to the constructive episodic simulation hypothesis, to imagine future events, information from past events is required to be recollected. Memory has a constructive role of gathering information, because the most significant function of memory is to prepare

information for the process of imagining future events. (Schacter, D.L., Addis, D.R & R.L. Buckner, 2007, p. 659) Information from memory of the past is required to be retrieved so as to consider the future. (Bar, 2007, p. 286) Episodic memory contributes to the simulation of future events in the constructive episodic simulation hypothesis. Arguing that episodic memory is a part of episodic foresight is a way to account for the links between episodic memory and episodic foresight. Episodic memory allows us to construct future events by providing us data from the past. (Suddendorf, 2010, p. 100) Actually, retrieval of past events is not advantageous when just retrieval does not prepare information for future events. (Busby& Suddendorf, 2005)

Common neural underpinnings are activated during simulating the future and remembering the past events. Functional considerations of mental time travel and episodic memory open new horizons for us to see their nestedness to time consciousness, because we try to determine their roles in functional evaluation of mental time travel and episodic memory. It seems that mental time travel and episodic memory share a common neural basis, and if we follow their relatedness to time consciousness, this sort of functional evaluation will contribute to understanding neural substrates of time consciousness and its role in survival strategy of humans.

2.4 Do episodic memory and episodic foresight differ in various respects?

Although episodic memory and episodic foresight have parallel underpinnings, they might also differ in various respects. I shall say that I prefer to continue using traditional sense of episodic memory in this section, because it captures how constructing imagining scenarios and recollection of past events are conceptually different somehow, but I must prevent misunderstandings of the meaning of episodic memory. This is another way to see the functional role of episodic memory system, which is episodic future foresight. In fact, the best way to follow this part is to focus on the role of episodic memory system in remembering past events and simulating

future episodes, and see the episodic memory as a system in which various roles are executed, such as construction of future happenings, with recollection of past events.

Neuroimaging literature reveals a relation between episodic future thought and remembering, but it should be noted that they also differ to some extent. Recollection of a personal memory with specific time and place should be identified in order to determine neural substrates of episodic future thought. For instance, participant might be asked to remember a feature of his first day of high school, or to remember the name of his high school. Both of these tasks involve the retrieval of a personal event, whereas knowing the name of it does not require remembering it at a specific time and place. (Szpunar, 2010, p. 149) Suddendorf quotes Okuda's findings that memories of imagined events involve fewer details than memories of real experiences. A study about development of episodic memory and episodic foresight capacities in children reports that children differentiate past events earlier than future events. (Suddendorf, 2010, p.101) Russell et al. (2010) found that 3-5 year old children do not have problem with past and present episodic thinking, while they have problems with their ability of episodic foresight. According to results of another research, personal future events are detailed less than personal past events, making positive episodes is more rated, because people tend to be positive while thinking about future, and representation of events occurring in the near future are more vivid than events occurring in the distant future. (Szpunar, 2010, p. 149) Schacter also argues that semantic memory might also contribute to the construction of future events. Semantic memory provides information about general features of events and this kind of information is also used in order to construct future events like information coming from episodic memory. Klein proposes that there might be different kinds of mental time travel ability, and different types of memory. Future-oriented mental time travel is one of these mental time travel types, in which memory, self and subjective temporality play crucial roles. In addition to the contribution of episodic memory, semantic memory also supports FMTT (future-directed mental time travel). FMTT cannot be proved merely in terms of episodic memory. Semantic memory is a necessary condition for future-directed thinking.

According to results of the study done by D'Argembeau and his colleagues, future-directed thinking requires both personal resources from semantic and episodic memory. (D'Argembeau et al., 2006; Klein, 2013) Likewise, findings from another research demonstrate that both episodic and semantic memory contribute to imagine future episodes. (Viard et al, 2012) Episodic memory contributes to some types of future-oriented mental time travel abilities, but it is neither necessary nor sufficient for some forms of FMTT such as simulation, foresight. (Klein, 2013) It is proposed that "semantic memory is both necessary and in many cases, sufficient for future-oriented projections of both personal and impersonal mental time travel" (Ibid., p. 69). Klein illustrates that K.C can make personally future-directed decisions, even if he cannot imagine himself in the future, and patient D.B can imagine future-directed impersonal events, even though he lacks of episodic recollective memory. Therefore, Klein says that the research area should be expanded beyond the types of memory in order to understand what future-mental time travel is, fully.

Then, Klein considered that subjective temporality and self are other components of future-mental time travel ability. However, what we mean when we use the term FMTT is important. Do we refer to an ability to construct personal future scenarios, public future scenarios; or to anticipate events, to predict out future attitudes? (Ibid., p. 71) Semantic memory which is restricted by non-personal scenarios contributes to FMTT, but it is suggested that semantic-based future self-projection is also possible. Humans can do future-mental time travels in a personal manner, although they are not able to access to their episodic memories. Semantic memory might include self-referential components, and might store information about self. (Ibid., p. 71) For instance, an amnesic patient, H.C. can construct future-oriented self-referential scenarios due to his intact knowledge in semantic memory. Since, self-knowledge lie in both semantic and episodic memory, as well as semantic-based FMTT ability is not limited to public scenarios. Episodic memory enables one to simulate future happenings, but semantic memory can also contribute to project oneself into the future. There might be several forms of temporality such as personal or public, self-referential or other-referential, whereas subjective

temporality and memory types are not bounded necessarily to each other. (Ibid.,p. 74)

My position is not that semantic memory does not contribute to mental time travel competence. Semantic-based future-oriented imaginings may include self-referential components and a number of data reveals that intact semantic memory may enable amnesic patient to construct future imaginings. It should be noted that semantic memory might store information about self. It appears that saying episodic memory contributes to mental time travel ability is not a limitation to the content of the information stored in semantic memory. Though, there is considerable discussion concerning the division between memory systems, despite concerns, the progress is derived from the current findings and obscurities. Although past experiences and future imaginings differ to some extent, as mentioned before this sub-part, they can also share common groundings which I cannot disregard. It is widely recognized that semantic memory stores the factual information, but acknowledging that the division between memory systems may not be clear cut and semantic memory may include self-referential knowledge which is not limited to the admitted scope, how episodic memory system is related to mental time travel ability should not be disregarded. Thus, the assumption that mental time travel, episodic memory and autoethic consciousness are related to each other is not a challenging view for the results that show the semantic contribution to the mental time travel ability. Episodic memory contributes to future-oriented projections of personal mental time travel. Even semantic memory is sufficient for future-oriented projections of mental time travel in many cases, it does not mean that episodic memory is not related to mental time travel ability, because future-oriented mental time travel ability can be performed by episodic memory.

It should be noted that a common capacity for active construction enables us to travel mentally in both directions. There might be differences due to the conceptual differences. For example, the future is not certain; while the past can be known but cannot be changed. (Suddendorf, 2010, p.101) The relation between episodic memory and episodic foresight looks complex, because the future and the

past cannot be separated in certain. Due to the fact that the future becomes past, the separation between them is dynamic, and a dynamic relation between episodic memory and episodic foresight is expected. (Ibid., p. 104) Our existing memories are updated to form analogies and generate predictions. (Bar, 2007, p. 282) In addition, “nestedness” can refer to fractality, and this alternative meaning of nestedness can help us to see the complex relation between recollection of past events and constructing imagining scenarios. Time proceeds each past Now becomes nested into the upcoming Now. Husserl’s views about time consciousness and how his construal of temporal structures, match with Vrobel’s account of time consciousness. Protensions become retentions when they pass through the extended Now.⁴ Susie Vrobel notes that duration which means that any sort of experience has a temporal extension is necessary for experience. Memory and anticipation converge in the Now, according to Husserl, but Now is not a point that divides past and future. Vrobel says that “the past Nows are nested in our present Now”. Similarly, “the present Now is nested into all future Nows” (Vrobel, 2011, p. 14). Vrobel concludes that Now has a nested structure. This construal of temporal structures accords with what Husserl says, that is, when we have retention, the time consciousness of the present and protention of something. (Ibid.) Thus, I said that one of the meanings of nestedness as fractality, due to the confusing relation between episodic memory and

⁴ Husserl refers to memory when he used the terms “retention” and “protention”. Time consciousness is focused and flows away like all experience. What appears to us as now becomes immediately past, but we are conscious of what is just past, what has just been now. The time consciousness of the just past is called “retention”. (Husserl, 1893-1917/1991, p.26) Temporal objects are in temporal modes of appearance such as now, past and future. An object appears to us in these temporal modes, and we become aware of its endurance. Even though an object is in those temporal modes, one temporal mode, which is Now, has a specific status, because it is the reference point for experience. Things or events appear as future or past with respect to their relation to the Now. (Husserl, 1893-1917 /1991, p. 16) “An actually present now” becomes a “past now” while it remains the same Now. Now appears as past, even if now mode is not really becoming past. The Now is past of a larger system where Past and Future are also dependent on. Husserl says that “the Now is a relative concept and refers to a past, just as ‘past’ refers to the ‘now’” (ibid., p. 70). According to Husserl, now supplies the reference for other temporal modes.

episodic foresight that appears to be dynamic, like the nature of time consciousness in Husserl.

It is remarkable that episodic future thinking is a significant function of episodic system. (Addis, Wong & Schacter, 2007, p. 1375) There are several numbers of papers investigating the nature of episodic future thinking. It is a typical ability observed in nature. Empirical evidence on episodic future thought concerned with “the frequency with which we think about personal future episodes in our daily lives, the content and phenomenological characteristics of episodic future thought, neural characteristics of episodic future thought, the co-occurrence of deficits of episodic future thought” might support the nestedness of mental time travel and time consciousness, because time consciousness is accepted as the underlying factor of the ability of episodic future thought (Szpunar, 2010, 149) Therefore, the outcome of further studies will show the episodic contribution to the simulation of future events, and the relation between episodic memory and foresight. Episodic memory system has a crucial role in future-directed thinking ability, and time consciousness is a determinant of episodic future thinking. It reveals that episodic future thought is nested to time consciousness, because episodic future thought is a skill which allows us to travel mentally into the past and the future. We shall also take into consideration auto-noetic consciousness, regarding mental time travel ability, since auto-noetic consciousness is agreed as an underlying factor of mental time travel capacity. All in all, a nested structure operates in time consciousness, depending on mental time travel and episodic memory. The roles that these nested structures play in time consciousness contribute the functioning of time consciousness as well, and they enrich each other’s role executed in this complementary system.

2.5 Is auto-noetic consciousness required for mental time travel?

The question posed in the subtitle 2.5 provides converging insight into how auto-noetic consciousness, mental time travel ability and episodic memory are

connected to each other. In this sub-section, I will review Klein's views on future directed mental time travel and auto-noetic consciousness. As mentioned in the previous sub-section 2.4, auto-noetic consciousness and future mental time travel is not intrinsically related to each other, even though Klein says auto-noetic future-oriented projection is related to episodic memory. He says if there is a relation between them, it is relational rather than intrinsic.

Even the claim that auto-noetic consciousness is requisite for mental time travel is not explicit enough, why future-directed thinking cannot be applied to auto-noetic consciousness thesis is not clear. At least, it should be considered that the possibility of auto-noetic consciousness' participation in future-directed mental time travel competence, like the contribution of it in experiencing past events. Episodic memory, which enables us to travel mentally into both past and the future, requires auto-noetic consciousness. Therefore, I propose that auto-noetic consciousness might be applied to mental time travel ability.

Klein contends that auto-noetic consciousness hypothesis operates well when applied to experiencing past events, however, applying auto-noetic consciousness to experiencing the future is not clear, because experiencing the past and imagining the future differ in various respects such as metaphysical, epistemological and experiential. (Klein, 2013, p. 72) Klein says that there is relevant empirical evidence which justifies connection between episodic memory and auto-noetic-future mental time travel, but not all of them support the relation between auto-noetic consciousness and mental time travel. He gives an example from a case study in which a Russian soldier is deprived of access to episodic and semantic self-knowledge, even though he has a remarkable ability and desire for planning his personal future. He says that this evidence shows us that he was not stuck to the present. Another case with an amnesic patient demonstrates that he can imagine personal future and can access to episodic personal content, but he cannot experience these contents as his own experiences. Amnesic patient lacks of awareness of experiences as his own. (Ibid., 73) Amnesic is not able to imagine himself in the future consciously. These findings from several studies reveal that connection between memory types and temporal

awareness is complex and he points out that auto-noetic future-oriented projection, supposing that he refers to the ability auto-noetic future mental time travel ability, might be related to episodic memory, but the connection between them is relational, rather than intrinsic to the system.

Episodic memory presupposes auto-noetic consciousness, and what allows us to make mental travels into the future and the past is episodic memory. It indicates that mental time travel competence and auto-noetic consciousness are related. In this section, I presented that auto-noetic consciousness is a prerequisite for mental time travel ability. Although all empirical evidence do not support the connection between episodic memory and auto-noetic- future directed mental time travel, Klein believes that they are connected relationally. This demonstrates us why we cannot disregard the role of auto-noetic consciousness in mental time travel. Auto-noetic consciousness contributes to remembering past events, and it also participates in future-oriented imaginings. The relational connection between episodic memory and mental time travel implies a connection between auto-noetic consciousness and mental time travel, because auto-noetic consciousness is suitable for episodic memory. The relation between auto-noetic consciousness and episodic memory, as a variety of memory system (Tulving, 1985, p.3) derives a connection between auto-noetic consciousness and mental time travel ability. Suddendorf underscores that episodic memory yields us to extract information from the past and it enables us to simulate future events. Therefore, admitting that episodic memory improves by orienting into the future, and mental time travel is an ability of humans which allows them to construct future episodes and remember past events consciously leads us to the connection between auto-noetic consciousness and mental time travel ability. Transferring auto-noetic consciousness to experiencing the future seems to me plausible due to experiencing the past and imagining the future may depend on common groundings, even though experiencing the past and imagining the future differ in various respects. As was discussed in the section 2.2, and 2.3, studies provide converging evidence that similar neural patterns are activated during imagining the future and recollection of past events, and simulating the future and remembering the past is disturbed in some

diseases. Episodic future thought is a remarkable function of episodic memory, while recollection of past events is accepted as a function of episodic memory traditionally. Even imagining the future, and remembering past events differ in various aspects, the relation between them should not be ignored, due to its integration into many other theories, such as consciousness. To dwell upon the nested relation between time consciousness, mental time travel and episodic memory, all similar respects that imagining the future and remembering the past share needs to be evaluated.

CHAPTER 3

THE ROLE OF MENTAL TIME TRAVEL AND EPISODIC MEMORY IN TIME CONSCIOUSNESS

I am also interested in whether anyone who has the ability of mental time travel has a mental self or subjectivity, that is, whether subjectivity is a precondition of the ability to mental time travel. When we address this question, we might be inclined to presuppose that conscious self is required to perform mental time travel function. In so doing, I will be taking into consideration the distinctions that several investigators make between, for instance, mental time travel/future-directed capacity, episodic memory/episodic-like memory. In order to explain the role of episodic memory and mental time travel in conscious human beings, the focus of my examination will be on the arguments concerning mental time travel and what episodic memory is, and how episodic memory contributes to the capacity of mental time travel. Episodic memory, mental time travel and time consciousness form a nested structure in humans. Being able to travel mentally into the past and future requires episodic memory which extracts data from past experiences to simulate future events. It seems therefore that mental time travel and episodic memory are intimately connected. Furthermore, humans who can travel mentally into the past and future have higher order time consciousness, while non-humans who are deprived of mental time travel capacity have a simpler form of time consciousness. It suggests us that mental time travel ability and time consciousness are nested, because failure of MTT causes non-humans to conceive their experiences from a different perspective from humans. These competences of conscious humans, which evolved as a result of their survival and reproduction, are mutually dependent. Indeed, this proposed account integrates contributions to time consciousness. Mental time travel implies episodic memory,

and mental time travel indicates to time consciousness. Crudely put, there is a strong relationship between mental time travel, episodic memory and time consciousness.

I have mentioned above that I will make a distinction between humans and non-humans in their mental time travel and episodic memory competence. If there are no animals other than humans who have mental time travel capacity, does this mean that they are not mental selves or subjects? Then, time consciousness might be a prerequisite for mental time travel. In that case, nonhuman animals, for instance birds building nests, scrub jays which hide their nuts from others, would be unconscious when they display such behaviors. Seeing that these animals do display these behaviors, such as migration, nest building, caching food they must be doing them merely to satisfy their current needs; so these behaviors are not examples of mental time travel. They must be just future-directed capacities as Suddendorf and Corballis argue. (Suddendorf& Corballis, 2007) When we make a distinction between humans and non-humans in their mental time travel ability, it seems that mental time travel competence belongs to humans, whereas non-humans do not possess this ability. Tulving says:

The only thing missing is evidence that they have human-like conscious recollections of their worm and nut caching activities. They may just “know” what kind of food is where, and what state it is in-fresh or rotten-without knowing how or why they know it. (Tulving 2001, p.1512)

Foresight has an important role in non-humans’ actions, but their behaviors are not as flexible as humans’ acts. Non-humans do have future-directed behaviors, whereas their behaviors are not indicative of mental time travel. Animals other than humans may exhibit prospection-like abilities.⁵ It is said that “episodic future thinking”,

⁵ “Prospection is the act of thinking about the future and is the prototypical example of self-projection.” (Buckner& Carroll, 2007, p. 50)

“memory for the future”, “mental time travel” and “imagination” are prospection related concepts. (Buckner&Carroll, 2007, p. 50) Szpunar also says that prospective memory and planning are future-oriented cognitive processes which are relevant to episodic future thought, but they are not the same mental capacities with episodic future thought. Prospective memory enables us to remember to perform intended events in the future. This intended activity represents a personal event belonging to the future, but it is not necessary that an intention be formed for the simulation of the future. Imagining when, where or how an event will occur is important to perform intended activities and evoke episodic future thought, but simulation of the future does not require plans about intentions. (Szpunar, 2010, p.145) Humans have a complex self-projection ability, while proto-forms of self-projection may exist in other animals. Fullest form of self-projection might be uniquely human for some researchers. (Buckner& Carroll, 2007, p.54, Tulving, 2002) Does the lack of mental time travel ability mean that non-humans are deprived of conscious acts as well? Mental time travel ability implies time consciousness, and mental time travel ability has a role in human time consciousness. Therefore, it is plausible to argue that there is a kind of failure, or at least a sort of difference in non-humans’ time consciousness, if mental time travel and time consciousness form a nested structure.

In addition, humans have qualitatively different episodic memory, while animals have episodic-like memory. (Roberts et al., 2008) Episodic memory enables us to locate events in time. (Corballis, 2011, p. 100) We consciously remember past events, or imagine future episodes. Corballis reported Schacter’s results from his fMRI study. Schacter found that both medial temporal lobe and prefrontal cortex are activated during remembering past or imagining future events. David Ingvar also reports that there is prefrontal cortex activation which provides connection between past and future. (Ibid., p. 101) Buckner and Carroll says that results show that prospection and remembering converge, divergent forms of self-projection, such as prospection and remembering the past share a common brain network. (Buckner& Carroll, 2007, p. 49) So, at least, there may be a kind of internal connection in remembering past and imagining future events. According to Corballis and Köhler,

mental time travel ability is unique to humans. According to Köhler, chimpanzees do not conceive future as we do, anticipation of the future is not flexible in chimpanzees. (Bischof-Köhler, 1985) Köhler's hypothesis puts forward and Corballis agrees that mental time travel might have evolved after the split between hominin and apes. (Corballis, 2011, p. 102) Some non-human animals display future oriented behaviors, such as caching palatable foods in birds, but this kind of acts are said to be a challenge to the view that mental time travel is unique to humans. Indeed, birds may not remember caching event, but they may know where the peanuts are. (Ibid., pp.102-103) Even though Corballis thinks that www-criterion is not sufficient for mental time travel, according to Eichenbaum and Dally, fulfilling the www-criterion may be sufficient to conclude that some animals travel mentally back in time. Namely, having information about what, where or when an event occurred is mental time travel into the past, according to Eichenbaum and his colleagues who think that www-criterion is sufficient for MTT. Some animals may also have future oriented behaviors, such as hiding food from thieves. Szpunar also says that prospective memory and planning are future-oriented cognitive processes which are relevant to episodic future thought, but they are not the same mental capacities with episodic future thought. Prospective memory enables us to remember to perform intended events in the future. This intended activity represents a personal event belonging to the future, but it is not necessary that an intention to be formed for the simulation of the future. Imagining when, where or how an event will occur is important to perform intended activities and evoke episodic future thought, but simulation of the future does not require plans about intentions. (Szpunar, 2010, p.145) Nonetheless, it does not mean that they travel mentally in time as we do. Non-humans might attach a kind of tag at the time of the event, and they would not have to remember the act of caching food. What we see as a kind of future directed behavior in scrub jays which hide their nuts from others may be a learned association between the scrub jay and the loss of food. (Corballis, 2011, p. 104) Learned association is not an actual imagination of the future event.

According to Bischof-Köhler hypothesis, only humans can anticipate future events flexibly. (Bischof –Köhler,1985) Non-humans future-directed acts are either fixed action patterns which are inflexible behaviors, without the requirement of the sense of future, or cued by their current motivation. (Raby, C.R. & N. S., Clayton, 2009) Selection of the freshest food in non-humans may be a consequence of a learning act rather than anticipation of a future event. (Corballis, 2011, p. 105) Thus, non-humans do not have episodic memory, even if they display future oriented behaviors. From the very beginning, I have stated that time consciousness, episodic memory and mental time travel are connected to each other, and proceed with the issue how they are related. It appears that mental time travel implies episodic memory, and it indicates time consciousness in humans. There is not a consensus of what consciousness refers in the literature, for instance Gennaro added another factor, namely self-consciousness, to the discussion of episodic memory. Gennaro claims that episodic memory requires self- consciousness. (Gennaro, 1996, p. 190) I mention a kind of temporal consciousness which allows us to be conscious of ourselves who is travelling in time and aware of ourselves along this temporal continuity. Time consciousness concept might be derived from the traditional memory systems hierarchy of Tulving. Fig 2 shows that Tulving classified memory systems (Tulving, 1972) and he attributed different versions of consciousness to each memory system. Episodic memory is related to auto-noetic consciousness. (Tulving, 1985) Thus, time consciousness which I thought as connected to episodic memory and mental time travel competence is also dependent on the Tulving's classical hierarchy of memory systems. I have considered a sort of temporal consciousness regarding auto-noetic consciousness, and episodic memory which allows us to be conscious along this temporal line.

TABLE I
A schematic diagram of the relations between
memory systems and varieties of
consciousness

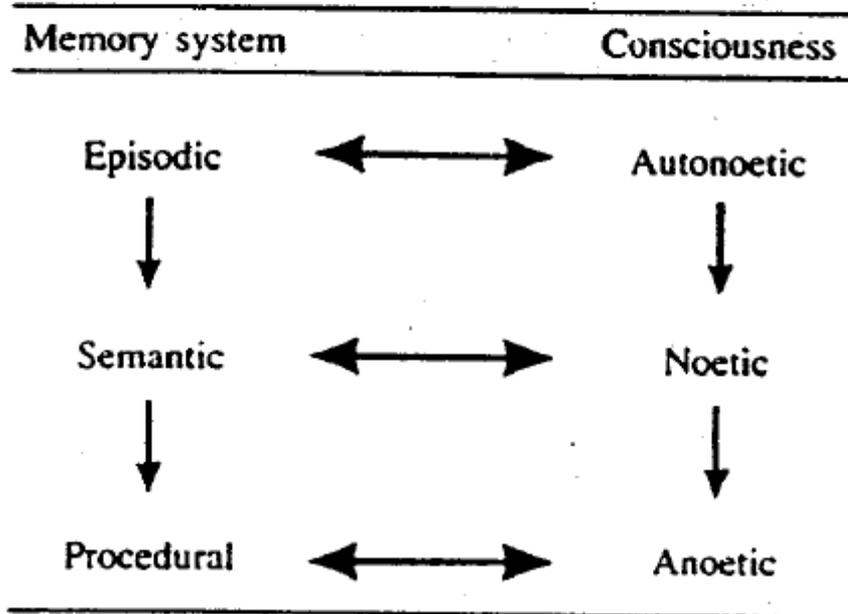


Figure 2. Correlation between memory systems and types of consciousness
(Tulving, 1985)

Gennaro used the term self-consciousness, but we can grasp that he emphasized the temporal property of consciousness in his utterance of self-consciousness. Tulving also supports this. Nevertheless, they all believe that mental time travel is a revised definition of episodic memory. Episodic memory refers both to re-experiencing past and being directed towards future. No matter what the direction of the event is along the temporal continuum you can re-experience/construct the event in question. Indeed, episodic memory is a constructive system rather than a reproductive system. (Schacter & Addis, 2007, p. 773) Adding future direction to the explanation is more plausible than seeing episodic memory only as a mechanism for retrieval of past events. A modification of the definition of episodic memory is necessary in order to understand the role of episodic memory in mental time travel. I think this understanding affirms the constructive role of both episodic memory and mental time

travel. Recent studies on episodic memory reports that episodic memory has a role in imagining future scenarios. (Buckner & Carroll, 2007, p. 49) Schacter and Addis argue:

The future is not an exact repetition of the past, simulation of future episodes may require a system that can draw on the past in a manner that flexibly extracts and recombines elements of previous experiences by constructive rather than a reproductive system. (Schacter & Addis, 2007, p. 774)

Reconstructive retrieval is an important feature of the episodic memory which allows us to simulate future scenarios. “We remember the past to envision the future.” (Buckner & Carroll, 2007, p. 55).

Gennaro approaches episodic memory in a broader context, and revealed that episodic memory entails self-consciousness. As Gennaro argues, this understanding is also meaningful for concepts and temporal continuum. (Gennaro, 1996, p. 191) On the other hand, if we commit to the view of Suddendorf & Corballis, and make a distinction between humans and animals with respect to their reconstruction ability and say that non-humans merely have episodic-like memory, it seems that animals do not have self-consciousness, because non-humans may not satisfy the necessary condition of self-consciousness that Gennaro already suggested. If episodic memory requires self-consciousness, it seems that non-humans may not have self-consciousness, since they do not have episodic memory. Their episodic-like memory is not as complex as ours. In order to grasp that non-humans lack episodic memory, and there is nested structure of episodic memory and time consciousness, it is necessary to make a distinction between humans’ and non-humans’ time consciousness levels. Saying that non-humans are not conscious in their acts seems as a premature reply, because there may be various parameters for time consciousness, other than episodic memory. Moreover, non-humans do have episodic-like memory and display future-directed acts, and it implies that they may have a simpler sort of time consciousness.

Suppose that we did not attribute episodic memory to nonhuman mammals and to some birds that update their information at the current moment and are

anchored in the present, then we may perhaps explain their behavior by their semantic memory.⁶ Since, as Schwartz observed, gorillas, like *King*, have some rudiments of an episodic memory system, even though they lack in complete retrieval by mental time travel. (Terrace & Metcalfe, 2005, p. 237) In this case, do they have self time consciousness also? Wheeler, Stuss and Tulving proposed that auto-noetic awareness enables us to represent past, present and future experiences in a highly subjective manner. In any case, Gennaro argued that humans are able to develop more complicated concepts than non-humans, even though they both have self-consciousness. (Gennaro, 1996, p. 198) And so, some non-humans might have rudimentary consciousness without having episodic memory. (Ibid., p. 195) If time consciousness and self-consciousness refer to the same thing, Gennaro's argument may be successful in explaining the conscious mind. It seems that time consciousness is a nested structure, or the roles that the factors play in time consciousness is nested. The functions of them are related to each other relationally. Mental time travel is a function of episodic memory. The failure of episodic memory in non-humans has an impact on the functioning of mental time travel, because they cannot perform mental time travel ability. For instance, the behaviors of non-humans might be evaluated as future-directed acts, because their future-oriented behaviors are not as flexible as humans. Non-humans do know some past events such as where they store their foods, but knowing where they store their foods is not enough, or sufficient for saying that they have episodic memory or do mental travels. They lack auto-noetic consciousness. Unique mental time travel ability and episodic memory system found in humans is an indication of distinctive, higher-order level time consciousness than non-human animals. At this stage, what Metzinger puts forward is more likely to convince us. Metzinger argues that there is not an on-off switch for time consciousness; thus it must be a graded phenomenon which has many aspects.

⁶ Memory systems are distinguished as semantic, episodic and non-declarative kinds of memories. Michaelian reveals that semantic memory and episodic memory are different at the computational level, and episodic memory system involves auto-noetic awareness. (Michaelian, 2011) According to the classification of memory systems of Schacter and his colleagues "declarative memory divides into episodic memory, which is concerned with the recollection of personal experiences, and semantic memory, which is concerned with the recollection of general knowledge" (Schacter, D.L, Wagner, A.D. & R.L. Buckner., 2000).

Memory is only one of its discernible properties. Metzinger also adds that the roots of time consciousness lie in the animal kingdom. (Metzinger, 2010, p. 19) In the fourth section of this study, I will review Metzinger's arguments about consciousness in a more detailed way, but now, I will continue with episodic-like memory systems in non-human animals.

3.1 Episodic-like Memory in Animals

In this subsection, I will touch upon why episodic memory systems in non-humans differ from human's episodic cognition. To say that, non-humans have episodic-like abilities, several definitions of memory systems and the difference of episodic memory among others have to be considered. Then, investigation of episodic cognition in humans and non-humans as well as a comparison between species can lead us to the assertion that non-humans do have episodic-like memory while humans possess episodic cognition. An outlook on episodic-like cognition in non-humans can show us the role of MTT and EM in time consciousness.

As the definition of episodic memory that I gave in the first part of the work suggests, EM "receives and stores information about temporally dated episodes or events, and temporal-spatial relationships among these events" (Tulving, 1972, pp.381- 403). Many researchers offer different descriptions of memory systems and memory systems are classified as episodic or semantic memory, and the like. "Episodic memory is concerned with the conscious recall of specific past experiences, whereas semantic memory involved the storage and retrieval of factual knowledge about the world" (Griffiths et al., 1999, p. 74). This classification is based on the difference between remembering and knowing an event. Griffiths illustrates that recalling that getting wet in rain the last Wednesday is an example of episodic memory, while knowing that the weather is often rainy in London is concerned with the semantic memory. (Ibid.) Even though several researchers offer definitions and classifications of memory systems, there is not a common view that all shares about

episodic memory. According to Tulving, episodic memory system requires auto-noetic consciousness. Remembering specific past experiences is accompanied by “auto-noetic” consciousness which is the distinctive feature of EM, and episodic memory is found in humans while non-humans do not have this kind of memory system for them. (Ibid., p. 76) I have stated earlier that I thought that auto-noetic consciousness is found on the grounds of time consciousness. I believe that auto-noetic consciousness and time consciousness co-occur together in episodic memory. In other words, auto-noetic-time consciousness is being aware of ourselves which experience a particular episode at a specific time. Auto-noetic consciousness is a property of time consciousness. A special case of mental time travel ability which enables us to imagine future episodes is performed by EM, and auto-noetic consciousness is related to EM. Indeed, I believe that temporal consciousness should not be thought quite different from auto-noetic consciousness.

Definitions of episodic memory with respect to conscious past experiences put a methodological restriction on the experimental evidence of episodic memory in non-humans, because there are not enough behavioral criteria of time consciousness in non-humans. Griffiths and his colleagues say that there is plenty of evidence for episodic-like remembering in non-humans, but familiarity rather than conscious recollection is obtained as agreed criteria from the results. Monkeys can complete matching tasks, but this might demonstrate us that monkeys are aware of the stimulus rather than recalling what, where or when the event happened. (Ibid.) Besides, there are other results that show us that non-humans can recall what, where and when an event occurred, and it is not possible to explain the behavior of an animal in terms of familiarity in those circumstances. According to Griffiths and his colleagues:

Scrub jays encode information about the type of food they store in cache sites, and that the birds can update their memory of whether or not a caching location currently contains a food item following recovery. (Ibid., p. 78)

Then they proceed to answer whether episodic-like memory in scrub jays is similar to episodic memory in humans. Results on scrub jays demonstrate that they remember wh- components of the event, but they don't fulfill "autonoetic" time consciousness criteria for episodic memory. This is a methodological problem which cannot be resolved, because "autonoetic" time consciousness cannot be tested in non-humans which do not have linguistic behavioral markers. Therefore, there is no evidence for episodic memory in non-humans, according to Griffiths and his colleagues. "How much information about an event an animal needs to remember for a memory to be classed as episodic as opposed to the summation of a series of semantic facts" remains as an unanswered question, and the claim that episodic memory is unique to humans is an irrefutable claim due to this methodological constrain. (Ibid., p. 79) Considering the episodic cognition in non-humans as episodic-like abilities is more plausible than saying non-humans do also have episodic memory. Humans and non-humans have similar episodic cognition abilities, whereas humans might have a unique version of it because of the feature of "time consciousness" in episodic cognition. It looks also methodologically impossible to test episodic cognition abilities in non-humans which do not have linguistically behavioral markers of conscious experience.

3.2 Mental Time Travel in Humans and Animals

Humans can travel mentally both into the past and future. There might be evidence for mental time travel in humans from their verbal reports, because they do have linguistically behavioral markers of their conscious experiences. Thus, the assertion that backward and forward travels are unique to humans cannot be refuted, since non-humans cannot report their behaviors linguistically to us, and there is not such kind of evidence gathered from non-humans. However, Zentall suggests that animals might not be stuck in time in the present completely, and they do mental travels to some extent. (Zentall, 2005, p. 208) Animals are able to retrieve information from

past, and also non-humans show evidence for planning, they are not completely stuck in time. (Ibid., p. 223) Animals can keep the passage of time, and they can “act on past experiences”, whereas, according to Zentall, they cannot remember them actively. Fulfilling www criterion might be a criterion for episodic memory, but fulfilling those properties of an event does not ensure that scrub jay or other animal have episodic memory, because differentiation of episodic memory from semantic memory is obscure. Knowing what, where or when an event occurred is neither necessary nor sufficient for episodic memory. (Ibid., p. 212) Flexibility is another criterion for episodic memory offered by Clayton and her colleagues. It is agreed as a necessary condition for episodic memory, but is also assessed as insufficient to distinguish semantic and episodic memory. (Ibid., p.213) Zentall argues that prospective coding shows that animals are apt to representing future events, while there is also evidence for the lack of future planning in animals such as research on choosing small rewards over larger delayed rewards. Humans maximize rewards, while non-humans select small immediate rewards to larger delayed ones according to King and Logue (King& Logue, 1987), and this show us that animals may not be able to do future planning as we do.

It seems that humans have a distinct mental time travel ability both into the past and future. There is evidence for future planning, and retrieval of the past comes from non-human experiences, and such evidence demonstrates us that animals are not completely stuck in time. Even though non-humans may be apt to do mental travels into the past and retrieve where, when, what occurred, it is not sufficient to conclude that they have episodic memory based on past experiences. There is not a clear cut evidence to distinguish semantic memory from episodic memory, and this is why non-humans may not retrieve past events actively. It is also procedurally impossible to test non-humans’ mental travels due to the lack of verbal reports by them. Further, non-humans may also perform mental travels into the future, and they might also do future plans to some extent. (Zentall, 2005, p. 222) Their behaviors directed to the future might not be as complex as humans, and humans might have a distinctive planning ability. In this way, considering non-humans’ future oriented

behaviors as simpler forms of unique version of human mental time travel capacity is helpful to understand the nature of time consciousness in humans and nestedness of time consciousness to mental time travel and episodic memory. It is more plausible to say that non-humans may display future-oriented behaviors and do future planning, but their behaviors are not as flexible as humans. Klein adds that temporal projective abilities do not differentiate us from non-humans and children. What differentiates is the level of their abilities. Non-humans and young children do not have planning skills as complex as, and as flexible as ours. (Klein, 2013) On the contrary, Hoerl insists on that non-human animals stuck in time like young children who live their lives in the present. Non-humans are not able to perform mental time travels, and are stuck in time because they are not apt to engage in tensed thought. (Hoerl, 2008, p. 492) He states that young children and non-humans do have notions of the past and the future, but their temporal horizon is not as wide as ours. Understanding causal relationships in which the outcome depends on the sequence of events is required to engage in tensed thought. (Ibid., p. 498) Humans perform mental time travel grounded actions in various contexts, and their ability is more flexible than non-humans. The planning of future scenarios is the skill that both humans and non-humans have, but mental time travel ability is a higher, and more complex form of it. A differential analysis of future planning skill offers us a way to see the nestedness of mental time travel, episodic memory and time consciousness. Auto-noetic consciousness and episodic memory are interconnected, and they co-evolved. (Markowitsch & Staniloui, 2011, p. 32) This is not just to see the planning of future as fractional. Humans do also have a unique version of time consciousness due to this unique form of mental time travel ability. We have to consider the degree of future planning skill in humans to explain the degree of time consciousness in them. The degree of future planning reaches to a unique version as a mental time travel capacity in humans, while non-humans do have a different version of future planning skill nested in a different degree of time consciousness ability. Crudely put, the question here is how humans have a higher degree of time consciousness nested to mental time travel and episodic memory, while non-humans display behaviors

grounded future planning and have episodic-like memories nested to a different level of time consciousness.

CHAPTER 4

MENTAL TIME TRAVEL AND EPISODIC MEMORY AS AN INDICATION OF HIGHER DEGREE TIME CONSCIOUSNESS

In this part of the study, I will try to briefly sketch out why human time consciousness is unique. If mental time travel ability and episodic memory are unique to humans, then mental time travel and episodic memory may be the key components of time consciousness in humans, since mental time travel and episodic memory might have an indicative role in time consciousness. To see the contribution of mental time travel and episodic memory in time consciousness, I will again follow the method of making distinctions between non-humans and humans. As Metzinger argues, time consciousness is a graded phenomenon and we cannot say that non-humans are totally unconscious in their acts. When their acts are evaluated in terms of episodic memory and mental time travel, they may not have mental time travel capacity or episodic memory. However, it does not mean that they are not conscious organisms. If time consciousness is a graded phenomenon, it should be expected to see that non-humans display conscious acts, but these acts would not be as complex as ours. Their level of time consciousness may be different from human time consciousness due to their lack of mental time travel ability and episodic memory. The unique version of time consciousness found in humans may be derived from the capacity of mental time travel and episodic memory.

4.1 A phenomenal model of the self

Let me first review Metzinger's arguments about Phenomenal Self Model (PSM) and the graded character of time consciousness. According to Metzinger, we have an inner perspective and become conscious beings when we have a phenomenal Ego which is the center of what we experience (as ourselves). (Metzinger, 2010, p. 7) After I consider Metzinger's views about time consciousness, I will discuss that human acts are not confined to the present, while non-humans might be stuck in the present. In considering some future directed behaviors in non-humans, it needs to be said that non- humans know some of their acts, rather than retrieve them through episodic memory. Human time consciousness may be different from non-humans, since it has been argued by Corballis that human acts extend in time. (Corballis, 2011, p.110) All in all, mental time travel and episodic memory are indicatives of time consciousness in humans, because reconstruction of future scenarios has a significant role in defining episodic memory and mental time travel. Satisfaction of only current needs means that non-humans do not imagine future scenarios in terms of retrieval of the past, even if they display some future-directed acts. They do these acts instinctively, owing to the fact that their future-directed acts are simple and inflexible. Reconstructive episodic memory plays no role in these future directed acts.

Metzinger uses the metaphor "Ego Tunnel" for conscious experience like Corballis' mental time travel metaphor. Consciousness is a phenomenon that evolves, and it allows organisms to have inwardness. Animals have time consciousness, whereas humans have a higher degree of it. The content of PSM that Metzinger proposes is the Ego.

Animals experience objects subjectively in this model but not themselves. According to Metzinger:

The Phenomenal Self Model (PSM) of *Homo sapiens* is probably one of nature's best inventions. It is an efficient way to allow a biological organism to consciously conceive of itself (and others) as a whole. Thus it enables the organism to interact with its internal world as well as with the external environment in an intelligent and holistic manner. (Metzinger, 2010, pp. 4-5)

Metzinger states that non-humans' PSM is akin to humans but is not at the same degree. Animals are conscious to some degree, but our consciousness model, our PSM, is unique. Humans represent themselves as representational systems and cultural evolution arises out of biological evolution due to the unique character of our PSM. (Metzinger, 2010, p. 5) Ultimately, we should understand conscious experience as a deep structure in animals which allow them to have an image of reality. "I" or "self" appears in conscious experience which is an inner image of ourselves. (Ibid., p. 7) This internal image of us includes our psychological states, bodily experiences, and our relations to the past, future and other beings as well. (Ibid., p. 7)

4.2 Development of Episodic Cognition and MTT in Young Children

Povinelli sought to enlighten "self's place in time" from a developmental perspective. (Povinelli, 2001, p. 75) A proper temporally extended self concept develops as a complex process for Povinelli. He states that at what age children acquire the ability of conceiving the temporal dimensions of the self has not been understood yet, therefore, he left his main interest, which is the relation between time and self concept in chimpanzees, aside.

According to Povinelli:

One possibility, of course was that young children's explicit awareness of their own past and future emerges in tandem with the very concept of self. Another possibility was that the temporal dimensions of the self are constructed gradually throughout late infancy and early childhood. (Ibid., p.76)

2-3 year old infants might not understand the relationship between recent past events and current physical state. They are not apt to "integrate successive present selves along a purported temporal-causal dimension" in Povinelli's developmental model. Povinelli's model does not stipulate 3-year-olds' lack of storing or imagining past or future events. (Ibid., p. 86) The possible temporal restriction of 2-3 year olds' current self-representations in no way necessitates the absence of memory of past self states or the inability to imagine future ones. They have simply not yet adopted an ontology in which those states can be placed within a temporal-causal continuum. (Ibid.)

Povinelli's explanation for the inability of representation of the self in human infants might be a challenge for the idea that most non-humans do not have mental time travel capacity, nested in time consciousness. If there was a lack of understanding the extension of the self in time ontologically, as Povinelli suggests, in human infants, they would have the ability of mental time travel in 2-3 years old. They do not perform mental time travel grounded actions before this age period. Povinelli says that older children represent themselves in time. Child can "organize past, present, and future representations under a temporally extended, metaconcept of me" (ibid., p. 87). Even though Povinelli is interested in empirical evidence from a different domain, namely human infants, he shares the same idea with Metzinger about extension of the self in time. Povinelli suggests that young children cannot conceive past events past due to the fact that they are not able to appreciate the causal arrow of time. (Ibid., p. 89) Humans develop a representation of self in time, for Povinelli, and what he sees as crucial in a "proper self" is the ability to understand the current place within the causal structure of time. (Ibid., p. 87) After

the crucial age period, children become the experts of self extending in time, and they have mental time travel ability. They capture the causal arrow of time after some period, and they conceive the extension of self in time completely. Before this critical age period, they do not have a fully developed representation of self in time. It seems as a kind of lack of organization of past-present-future representations under a temporal self. Even if children display temporal representations, they start to organize them wholly after they are 2-3 years old.

To understand the nested structure of time consciousness, and mental time travel, I utilized various studies from non-humans, which highlights that non-humans may not do mental time travels. Starting from non-humans' deficiencies is an effort to understand what happens in other species. What Povinelli proposes is not about non-humans, but his study of children's self-recognition which supports that "the development of young children's temporally extended selves may involve a more general understanding of the causal structure of time" provided information for the emergence of self in time. What the understanding of the causal structure of time is also needs to be elaborated. (Ibid., p. 92)

Metzinger alleges that emergence of a sort of inwardness in systems is a recent phenomenon. A rudimentary form of consciousness may have appeared 200 million years ago, and primitive mammals might have had a sort of awareness of the external world and their bodily behaviors. (Metzinger, 2010, pp. 15-16) However, our distinct ability of PSM that other animals lack is turning the first order perspective inward. Additionally, Metzinger says that "the true remarkable fact is that we can also attend to the content of our PSM and form concepts about it" (ibid., p. 16). What humans possess is a higher level of PSM than the one in non-human animals. Having higher-order level PSM enables us to turn the first person perspective inward, and this level of consciousness becomes a unique property in humans. In short, mental time travel and episodic memory which Corballis and Suddendorf see as a unique ability of humans are probably other capacities which allow us to possess a distinctive higher order level of PSM than non-human animals.

Following Metzinger's PSM model, "ego tunnel" is also a time tunnel which allows us to have inwardness in subjectively experienced temporal domain. (Ibid., p. 34) An event referring to past or a plan about future are embedded in a conscious self that has inwardness in time. Furthermore, time consciousness also provides animals to be in this current moment. Metzinger points out that all conscious thoughts are in the immediate present, and the sense of presence is required to have conscious experience, whereas there is not an actual now-ness in our perceived world, because neural processing takes time, and what we experience as the present becomes the past. (Ibid., p. 37) Thus, the perceived Now is an illusion. A subjective experience has many aspects one of which is inwardness of the passage of time that is also a subjective phenomenon due to the fact that now-ness of an instant is also an illusion. (Ibid., p. 38) The pivotal property of animals is this lived now, because their brains evolved this kind of time experience.⁷ I would prefer to pursue the view that time consciousness is a phenomenon which animals have, whereas humans have an evolved version of it to a higher degree. Corballis tells that animals are chained to the present, and they do future directed behaviors, in order to satisfy their current needs, while humans are not confined to the present, and they travel mentally into past and future. It seems that "virtual window of presence"⁸ is not a sufficient condition for conscious experience and temporal inwardness. "Virtual window of presence" might be a physical property of animals for Metzinger. (Ibid., p. 39) If we agree with Corballis that mental time travel enables us to have (virtual) window of presence that Metzinger suggests, we are not stuck in our current needs, the answer to the question of why humans differ from non-humans is that humans are not chained to the present. Actually, our actions do not only involve satisfaction of current needs. This

⁷ Metzinger also mentions that other conscious beings in the universe might have a different version of time experience from non-humans. (Ibid., p. 39)

⁸ Metzinger says that virtual window of presence, which is the lived Now, is a property of biological nervous systems. They represent time by the emergence of this property. "Conscious minds can be situated only in one single, real Now at a time" and Metzinger sees as difficult to "imagine a situation in which experiencing multiple lived presents might have been adaptive" (ibid., p. 39). Therefore, "virtual window of presence" provides humans and some other higher animals an appropriate illusionary present among numerous perspectives to represent the passage of time. (Ibid., p. 40)

might be the reason why our level of time consciousness differs from non-humans. If mental time travel and episodic memory are unique to humans, these abilities might be the features of time consciousness in humans. Moreover, Corballis says that “natural selection cannot operate on the basis of past recollection per se, but only on what it contributes to survival in the present and future” (Corballis, 2011, p. 100). As I have mentioned earlier, mental time travel allows humans to recall past events and imagine future events. (Ibid.) So, conscious humans can travel mentally both into the past and future, while non-humans are not apt to have mental time travel capacity. If the level of human time consciousness is distinct from non-humans, mental time travel capacity found only in humans might be another contributory factor of this unique version of time consciousness in humans.

Humans have a complex mental time travel capacity, while non-humans have inflexible, simple future directed capacities. Corballis says that “mental time travel implies the conscious acting out of episodes, whether past or future, which further suggests recursion” (Ibid., p. 106). Indeed, recursion may be captured by the fractal concept of time. Mental time travel allows us to have the concept of a conscious self that extends in time. (Ibid., p. 110) Corballis indicates that Hazel Markus and Paula Nurius used the term: “ ‘Possible selves’ which are derived from representations of the self in the past and including representations of the self in the future” (Ibid., p. 110). According to Corballis, we construct future events, and reconstruct past episodes with the help of episodic memory that only humans possess. We have limited data from non-humans’ mental time travel ability due to their failure in language. Nevertheless, it seems that their actions are instinctive, while humans have a complex mental time travel grounded in their behaviors. Time consciousness, episodic memory and mental time travel are connected, and function depending on each other. Non-humans do not possess episodic memory and they do not have mental time travel ability, and their time consciousness level is a simpler form of inwardness in temporal domain. What I mean by nested structure may be a hierarchical structural relation between mental time travel, episodic memory, and time consciousness, or the fractal property of time consciousness which manifests

itself in mental time travel and episodic memory. One of the levels in this hierarchical relation implicates the other level. Mental time travel as a function of episodic memory indicates higher-degree time consciousness in humans.

What if nestedness refers to fractality? If it refers to fractal, it is compatible with what Povinelli says about the development of episodic cognition and mental time travel, Metzinger's Phenomenal Self, and the recursive nature of language (I will explain how recursive language indicate time consciousness in next sub-section), and mental time travel. This nested structure of time consciousness may be interpreted as an ability of construing ourselves who exist in time. Present comprises both retentions and protensions, namely the memory of past self and anticipation of the future self. Thus, self is formed along the time line, by past selves who comprise both retentions and protensions; and projections of future selves which involve retentions and protensions as well. Our temporal self is recursively embedded in itself.

4.3 Recursive language and mental time travel as indications of human time consciousness

In this section, I will try to provide arguments in favor of the idea that mental time travel is an indication of a unique human time consciousness. In order to support this claim, I examine the idea that humans have a distinct language faculty which enables them to convey infinite messages, while non-humans communicate merely with their limited gestures or symbols. Recursive mind of *Homo sapiens* is unique and it provides humans to perform various activities such as reconstructing past episodes and imagining future events. (Corballis, 2011, p. 181) Recursive language may be subsidiary to mental time travel ability, and they might have evolved together. (Ibid., p. 113) Mental time travel is not itself the sole recursive function which has a bearing on language evolution. (Ibid., p. 127) As Suddendorf puts it: "the recursive nature of language evolved, at least in part, from the recursive nature of mental time travel"

(ibid.). If open-ended generativity contributes to mental time travel ability in humans, it is possible to say that open-ended generativity has also a big impact on having higher level time consciousness. The fact that non-humans do not have conscious experiences that are as flexible as those of humans shows that their level of time consciousness is different from ours. In addition to this, they cannot communicate infinite messages, because their language is restricted to a limited domain. (Ibid., p. 221) Hence, open-ended generativity might be another indication of higher level time consciousness.

The use of language can provide us with mental time travel capacity. The view that language and mental time travel are linked in the evolution of species looks quite exciting, because the failure of language in non-humans may be due to their inability for mental time travel. Mental time travel enables us to share our future plans, so that we do not have to live in the present as non-humans do. (Ibid., p. 120) Predictions play important role in language comprehension and sentence integration. (Bar, 2007, p. 286) Some non-human species communicate with their gestures or visual symbols, but humans communicate with finite symbols, but these finite symbols' combinatories, and their use is infinite and flexible.

Since humans can produce infinite sentences with finite symbols, a generative and recursive communication system emerges in humans relatively quickly, even though participants are prevented to use previously used ways of language, i.e. sign language. Communication and language are integral parts of human cognition which emerge even under impoverished conditions. Galantucci (2005) prevents his experimentees to use pre-established ways of communication, but a communication system emerges in the laboratory. Participants also develop a new form of communication system according to their needs, based on their previous way of communication. So, the ability to use symbols to share past or future events might be unique to humans. The spontaneous emergence of communication structures reveals about the generative and recursive concept of language and mental time travel.

To support the unique language ability of humans, Corballis points to the fact that all languages have markings which indicate past, present or future. Humans distinguish time by tense in many languages. There are also languages in which verbs are without tense. Nevertheless, time is marked in different ways in these languages, as in Chinese. Consequently, language may be an outcome of the experience of time and the capacity of mental time travel. (Corballis, 2011, p. 120) The Piraha language spoken by the Amazonian Indians includes only two temporal markers, and this may give us their temporal self and presence along temporal line as a hint. (Markowitsch & Staniloiu, 2011, p. 26)

Even though non-humans also communicate to some degree, human language has the character of generativity. An alluring facet of recursion is that it can extend without limit so as to construct thoughts (sentences) of whatever complexity is needed. (Corballis, 2011, p. 8) Communication between humans includes reconstructing past episodes or imagining future scenarios. Humans might have a distinctive language capacity. Recursion must be the unique character of human language and mental time travel. Recursion provides humans to construct infinite messages. (Corballis, 2011, p. 221) This might be the reason of the limited capacity of language and the future directed behavior in non-humans. Recursion is accepted as the most important character of human language. (Hauser et al., 2002) If recursion is one of the most important characters of human language, and MTT can be assessed in humans through the use of language, it is plausible to say that humans may have a higher level time consciousness because of the open-ended generativity. Mental time travel might have evolved together with language and it is unique to humans, and there is a kind of difference in human and non-human subjective experience of time; as a result, language and mental time travel can indicate human time consciousness. Humans share their mental travels into the past and future with their language faculty. (Corballis, 2011, p. 113) Non-humans may not have a complex, unlimited, generative language due to their failure of MTT. Episodic memory, auto-noetic consciousness and mental time travel appear between the ages of 4 and 5. The main function of episodic memory is social, and social context plays a critical role in the

development of episodic memory, self, and mental time travel capacity. Even if language is not a necessary condition for episodic memory, it enriches its development. (Tulving, 2005) The relation between episodic memory and autothetic consciousness can be grasped from various perspectives. For example, they appear in accordance with the ability of language. (Markowitsch&Staniloui, 2011, p. 31) Language and mental time travel might have co-evolved as proposed. (Suddendorf, Addis & Corballis, 2009; Corballis, 2011) This proposal is relevant to my idea that language and mental time travel indicate human time consciousness.

Focusing on recursion, which is seen as one of the most important properties of language reveals that an analogy between language and mental time travel can be set. Common dependence on recursion in mental time travel and language supports that recursion in mental time travel and language may indicate human time consciousness. Linguistic recursion and going back to an embedded point or going forward to a projected point are similar operations, because they have similar structural conditions. Corballis (2011) sees recursion as an organizing principle in various mental attributes, from language to memory, and asserts that a recursive, distinctive human mind evolved. (Corballis, 2011. pp. 14-15) If time consciousness is a general feature of humans, and mental time travel is one of the recursive functions, which is related to the evolution of language, then it appears that the recursive nature of time consciousness might have evolved from the recursive nature of mental time travel, and language. Time is supposed to have a fractal structure in which we exist. Time consciousness includes a self which is recursively embedded to itself in this temporal domain. It is a temporal self which comprise past and future oriented presence in this temporal line. The recursive nature of temporal structures which allows convergence of past and future in the Now, enables us to experience objects in temporal modes. Now has a specific status according to this understanding due to the fact that it becomes a reference point for experience. Hence, the recursion in time consciousness is derived from the recursion in temporal structures. If nestedness refers to fractal, and time is conceived as a fractal, and recursive temporal structure which flows away, in which past Nows are nested into upcoming Nows,

this reveals us that recursion in time consciousness, an embedded temporal self should not be disregarded in the evaluation of consciousness. We are organisms who exist in time, and the fractal structure of time may have a big impact on its construal, because we are temporal selves embedded to our past memories and future anticipations. Perhaps, our experience of time is relevant to our time consciousness. Although the meaning of fractal is not the sole meaning of the nestedness, I would not like to leave aside this interpretation of it. The nested structure of time consciousness might be evaluated as an ability of ourselves who extends in this fractal temporal line.

Recursive nature of language and mental time travel in humans indicate unique version of higher degree time consciousness in humans, because time consciousness is a general mental attribute of humans which allows us to be conscious of ourselves who travel in time and to be aware of ourselves which experience a particular episode at a specific time along the temporal line. Time consciousness is agreed to be a graded phenomenon which provides an inner perspective in temporal line, and enables us to mentally represent experiences in the past, present and future. Our temporal self is recursively embedded within it. In that respect, keeping the concept of fractal time avails us to see the relation between language and mental time travel, and how they indicate time consciousness. If we take the meaning of nested as fractal and argue for fractal time, it appears that language and mental time travel depend on recursion. Recursion is captured by fractal concept and it is one of the characters of human language. So, language may become in fractal structure, as well. Thus, self-similarity in the nature of language supports the idea that language, and mental time travel which co-evolves with it, indicates time consciousness. I expect to see that a recursive mind has an impact on time consciousness and the recursive nature of language and mental time travel are indications of time consciousness. This idea may support the unique version of higher level time consciousness in humans due to unique recursive mind in them, and their unique mental time travel ability, and recursive language which are not found in non-humans. As long as how time is supposed to have a fractal structure is

understood, the alternative meaning of nested structure will remain as an unresolved issue of my thesis.

CHAPTER 5

CONCLUSION

In this work, it is considered that mental time travel ability, episodic memory and time consciousness form a nested structure. Distinguishing humans and non-humans is a method to understand the role of mental time travel, episodic memory, and other possible factors in time consciousness. First, I introduced working definitions of mental time travel and episodic memory. I discussed that mental time travel competence is dependent on episodic memory which allows humans to simulate future events with the information acquired from the past. I examined a functionalist analysis of mental time travel and episodic memory to see how they may be connected. To do this, I presented how memory systems are classified, and what the imagining the future means. Then I evaluated imagining the future as a function of episodic memory. I also elucidated episodic memory impairments to show that patients with impairments of episodic memory may be deprived of imagining future scenarios. The next sub-section stands for the idea that remembering the past and imagining the future may depend on a common memory system, and I discussed a neural overlap that occurs during remembering the past and imagining the future.

Then, I introduced why episodic memory and episodic foresight differ in some aspects. Even though it can be objected that semantic memory contributes to mental time travel, I considered that episodic memory, mental time travel and time consciousness are connected. I addressed the question whether auto-noetic consciousness is required for mental time travel or not, and proposed that auto-noetic consciousness might be connected to mental time travel ability as well. Auto-noetic consciousness can also be applied to experiencing the past and imagining the future.

Although not all empirical evidence support the relation between autothetic consciousness and mental time travel, we have evidence which supports the connection between them. Therefore, I did not disregard similar respects in remembering the past and imagining the future, while I was dwelling on how they differ from each other.

In the third chapter, I tried to expand the issue by exploring the role of mental time travel and episodic memory in time consciousness. I discuss that the roles that mental time travel ability and episodic memory play in time consciousness are connected. Humans have mental time travel ability into the past and future, and they have episodic memory, while non-humans lack mental time travel ability, and they have episodic-like memory. The fourth chapter is an effort to understand the uniqueness of mental time travel competence and episodic memory in humans, and their key, indicative role in human time consciousness. Human actions are flexible, and humans have mental time travel ability and episodic memory. It seems that these unique competences of humans are key contributory factors of the features of human time consciousness. Mental time travel allows humans to have the concept of a conscious self that extends in time. (Corballis, 2011, p. 106)

Finally, as Corballis suggests in *The Recursive Mind: The origins of Human Language, Thought and Civilization*, recursion might be the unique feature of human language and mental time travel. If open-ended generativity is a significant character of human language and mental time travel ability which only humans have, it is possible to speculate that humans have a higher order time consciousness due to this open-ended generativity. Non-humans do not construct infinite messages, and they do not travel mentally into the past or the future, hence, their level of time consciousness is different from humans. In short, open-ended generativity contributes to mental time travel ability. On this basis, it is plausible to say that open-ended generativity might be an indication of higher level time consciousness.

Perhaps the relationship among mental time travel, episodic memory, and time consciousness is not crystal clear. The most important implication of this work

is the suggestion of how a nested structure in time consciousness depending on mental time travel and episodic memory, is working, even though to what nestedness refers has not been explicit enough yet. I discussed the notion of nestedness which I use to express the connectedness of mental time travel, episodic memory and time consciousness. There might be other parameters other than episodic memory and mental time travel, functioning in time consciousness, whereas I kept the list short in order to see their contribution to time consciousness. Nested structure can either refer to the meaning of a hierarchical relation between time consciousness, mental time travel ability and episodic memory, or fractality, which manifests itself in mental time travel, and language. If the meaning of nestedness is fractality, it fits nicely what I mentioned in the part 4.1, 4.2, 4.3. Time consciousness is recursively embedded within itself, and is formed by the memory of past self and anticipation of future self. Even we mean an interdependent relation between time consciousness, mental time travel and episodic memory, by disregarding the meaning of fractal, one of the levels implicates the other level, that is, time consciousness, mental time travel and episodic memory are related and they function depending on each other. Episodic memory, which allows us to travel mentally into both past and the future, presupposes auto-noetic consciousness. Auto-noetic consciousness relies on the definition of episodic memory, and it might also be applied to imagining the future. Mental time travel and episodic memory may not be necessary for human time consciousness, but these unique competences of humans provide evidence of higher-level time consciousness. To understand temporal self, time consciousness, or the self along the temporal line, we utilized the notions of mental time travel, episodic memory, and auto-noetic consciousness, and tried to clarify them.

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APPENDIX



TEZ FOTOKOPİ İZİN FORMU

ENSTİTÜ

- Fen Bilimleri Enstitüsü
- Sosyal Bilimler Enstitüsü
- Uygulamalı Matematik Enstitüsü
- Enformatik Enstitüsü
- Deniz Bilimleri Enstitüsü

YAZARIN

Soyadı : _____
Adı : _____
Bölümü : _____

TEZİN ADI (İngilizce) : _____

TEZİN TÜRÜ : Yüksek Lisans Doktora

1. Tezinin tamamı dünya çapında erişime açılsın ve kaynak gösterilmek şartıyla tezinin bir kısmı veya tamamının fotokopisi alınsın.
2. Tezinin tamamı yalnızca Orta Doğu Teknik Üniversitesi kullanıcılarının erişimine açılsın. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.)
3. Tezim bir (1) yıl süreyle erişime kapalı olsun. (Bu seçenekle tezinizin fotokopisi ya da elektronik kopyası Kütüphane aracılığı ile ODTÜ dışına dağıtılmayacaktır.)

Yazarın imzası _____

Tarih _____