

## **Embodied Episodic Memory: a New Case for Causalism?**

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**ABSTRACT.** Is an appropriate causal connection to the past experience it represents a necessary condition for a mental state to qualify as an episodic memory? For some years this issue has been the subject of an intense debate between the causalist theory of episodic memory (CTM) and the simulationist theory of episodic memory (STM). This paper aims at exploring the prospects for an embodied approach to episodic memory and assessing the potential case for causalism that could be founded on it. In a critical section, it argues that the empirical data to which STM appeals are both incomplete and inconclusive, and on closer examination even provide support for a proceduralist version of CTM. In a constructive section, it elaborates on the notion of a necessary causal connection in terms of particular procedural patterns acquired at encoding and operative at retrieval, grounding this move on recent empirical data about eye movements in mnemonic mental imagery.

*Keywords:* Episodic memory, procedural memory, embodied cognition, sensorimotor view, causalism, simulationism.

**RÉSUMÉ.** La mémoire incarnée : une nouvelle défense du causalisme ? Une connexion causale appropriée à l'expérience passée qu'il représente est-elle une condition nécessaire pour qu'un état mental soit un souvenir épisodique ? Cette question donne lieu depuis plusieurs années à un débat intense entre la théorie causaliste (CTM) et la théorie simulationniste (STM) du souvenir épisodique. Cet article vise à explorer la perspective ouverte par une approche incarnée de ce type de souvenir, et à évaluer la possibilité d'élaborer grâce à elle une défense du causalisme. Dans une section critique, il soutient que les données empiriques auxquelles STM fait appel sont à la fois incomplètes et non-concluantes, et qu'à y regarder de plus près elles suggèrent même d'adopter une version procéduraliste de CTM. Dans une section constructive, il élabore la notion d'une connexion causale nécessaire en termes de schèmes procéduraux particuliers acquis à l'encodage et opératoires lors de la remémoration, et il appuie cette proposition sur des données empiriques récentes relatives au rôle des mouvements oculaires dans l'imagerie mentale mnésique.

*Mots-clés :* Souvenir épisodique, mémoire procédurale, cognition incarnée, conception sensorimotrice, causalisme, simulationnisme.

### **1 – INTRODUCTION: EMBODIED COGNITION AND THE DEBATE BETWEEN CAUSALISM AND SIMULATIONISM**

Is an appropriate causal connection to the past experience it represents a necessary condition for a mental state to qualify as an episodic memory? By episodic memory, I shall mean the type of memory representing past experiences of events that a subject has undergone and that typically involves mental imagery at retrieval (Tulving, 1985, 2002)<sup>1</sup>. There has been an intense

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<sup>1</sup> In what follows, absent further specification, “memory” will mean “episodic memory”.

debate for some years between the causalist theory of episodic memory (CTM) and the simulationist theory of episodic memory (STM) over the issue of causation in episodic memory. Behind this debate, one finds the philosophy of mind's project to carve up the mind at its joints. Cast in the idiom of cognitive science, the problem is to determine what the main components that comprise a cognitive system are and how they relate to one another. A core implication of CTM is that memory and imagination are different capacities that issue different cognitive achievements, while on STM memory is nothing but a species of imagination<sup>2</sup>. In other words, depending on whether one endorses either a causal or a non-causal definition of what constitutes an episodic memory, one will conceptualize episodic memory either as a cognitive capacity distinct from imagination or as a cognitive capacity akin to imagination. From this basis, one will thus be led to advocate for different pictures of the structure of the human neurocognitive system. Let us specify the opposing views.

On standard CTM (Martin and Deutscher, 1966; see also Bernecker, 2010 and Michaelian, 2011, though they depart from standard CTM), an appropriate causal connection is a necessary condition of episodic memory to the effect that it is required in order that the representational information (for short: the content) acquired during the past experience be transmitted to the present mnemonic mental state. But critics of standard CTM have questioned the neurocognitive plausibility of such a transmission (Robins, 2016; Michaelian, 2016) by invoking empirical data that suggest it is both unlikely and unnecessary. This has cleared the way for so-called post-causal theories, on which no appropriate causal connection is necessary (Michaelian, 2016; Fernández, 2019; see also Addis, 2020). The most prominent and explicitly anti-causalist view is STM, on which (in brief) remembering is “simulating or imagining episodes from the personal past” (Michaelian, 2016, p. 97). However, a recent reply to STM has suggested that CTM can be amended to produce a version that does not imply transmission of content (Perrin, 2018; Werning, 2020). In particular, on Perrin's proceduralist view (Perrin, 2018; Michaelian and Sant'Anna, 2019), inspired by Kolers's work (Kolers & Roediger, 1984), the necessary causal connection links the *procedures* required by the reconstruction of the memory to the ones required by the construction of the past experience, rather than the respective *contents* of the past experience and the memory of it. Perrin's proceduralist causalism does not endorse the notion of a particular causal connection, however, granting to the critics of CTM that our neurocognitive system is such that a distinct particular connection to the past is very unlikely. Instead, he makes a case for a necessary connection between *types* of experienced events and correlative types of episodic memories, with the particularity of the content of memories being provided at retrieval by the phenomenology of remembering—due to processing fluency, the memory is interpreted as resulting from a particular past experience – and by semantic memory – semantic information is expected to supply the particular spatiotemporal address of the event represented by the memory.

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<sup>2</sup> A further possible option suggested to me by Francesco Iani would be to conceptualize imagination as a species of memory.

Capitalizing on the proceduralist picture, in this exploratory paper I will assess whether taking into consideration the sensorimotor nature of episodic memory can provide reasons to think that it typically involves *particular* causal connections to the remembered past experience. In other words, rather than taking for granted that the embodied approach only re-embodies cognitive systems, as it were, while remaining neutral on the issue of what particular components comprise these systems, I shall examine whether the embodied approach could have implications for the question of the components that comprise the systems. Specifically, I shall ask whether it supports the notion of a particular causal connection involved in episodic memory, and accordingly, a strong distinction between imagination and memory. The paper comports two parts. In the critical part (section 2), I will argue against STM that the empirical data it calls on to counter the causalist claim that something – content, for standard CTM – is transmitted over time are both incomplete and inconclusive, and shall argue that on closer examination these very data even suggest that there *is* a causal connection between the past experience and the present memory, though this connection does not consist of a transmission of content<sup>3</sup>. In the constructive part (section 3), and building on the critical discussion of STM, I shall advocate a qualified sensorimotor approach to episodic remembering, on which particular procedural patterns are transmitted over time in such a way as to provide resources on which the success of remembering depends. Appealing to recent empirical data on patterns of eye movements involved in the imagery of episodic memory, I will consider the possibility that this dependence forms at least a part of the causal connection CTM has been searching for.

## 2 – PROBLEMS WITH STM’S ANTI-CAUSALIST ARGUMENTS

In this section, I introduce the causal theory of memory in its standard version and the criticisms raised against it by STM, diagnosing that the main STM’s anti-causalist move is to reject the necessity of a transmission of content over time. Then I proceed to show that the empirical data to which STM appeals are both incomplete and inconclusive. Instead, I will say, they bring support to the notion that our episodic memories involve a causal connection to the past, even though this connection does not consist of a transmission of content.

### 2.1 - The debate around CTM

#### *Definition of standard CTM.*

On Martin & Deutscher’s (1966) seminal paper, for a mental state to qualify as an episodic memory, it must be linked to the past experience of the event it represents by a causal connection. Specifically:

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<sup>3</sup> I will thereby echo and endorse Robins’ (2020a) recent contention that those who insist there is an important difference between remembering and imagining—a claim that favours so-called “discontinuism” (Perrin, 2016)—have good empirical reasons to oppose simulationism and its “continuist” stand. Though for different reasons, I will like her advocate “a naturalistically oriented, empirically-informed discontinuism between memory and imagination” (2020, p. 1).

- (CTM) A subject S has an episodic memory M of a particular past event *e* if and only if
  - S had an experience E of *e* in the past.
  - S has now a representation M of *e*.
  - M has an appropriate causal connection to E.

A straightforward question raised by this definition is what the allegedly necessary causal connection is. In other words, what are the conditions this connection has to satisfy to be an *appropriate* connection and to be part of the definition of episodic memories? Intuitively, being appropriate for a causal connection involves three conditions. (1) Firstly, there must be a causal continuity between E and M. By this condition, Martin and Deutscher intend to exclude cases like the following one. Imagine S underwent E in the past, but suffered a blow of such a strength that any trace of E is removed from his brain. Later on, during a session of hypnosis, the hypnotist tells S of an event that is, by luck, strictly similar to *e*. Thus, when the hypnotist awakens S, S has a representation of *e*. Since no *causal* connection relates the representation of *e* introduced by the hypnotist to E, Martin and Deutscher claim that it does not qualify as an episodic memory. (2) Secondly, E must be causally operative in the production of M. Martin and Deutscher thereby intend to exclude cases like the following: Imagine S underwent E in the past, tells his friend S' of M, then suffered a blow such that any trace of E is removed from his brain. Later on, S' relates back to S the memory that he (S) had told him before suffering the blow. Thus, by relearning M, S has now a representation of an event *e* he experienced in the past and whose experience is the causal source of his current representation of *e*. Since no *direct* causal connection relates the representation of *e* as reintroduced to S by S' to E itself, Martin and Deutscher claim that it does not qualify as an episodic memory. (3) Lastly, the causal link between M and E must take the form of a trace structurally analogue to E. Martin and Deutscher thereby intend to exclude cases like the following: Imagine S had E in the past, that there is a direct causal connection between M and E, but that what E has left in S is a state of suggestibility such that as someone prompts S about *e*, S produces a representation identical to his past experience of *e*. Since it is not E that is stored in S – more precisely: not a structural analogue of E – Martin and Deutscher claim that the representation of *e* in S due to his suggestibility does not qualify as an episodic memory.

Overall, actual causal connection, direct causal connection, and structural analogue traces are the three conditions for a causal connection between E and M to be considered as appropriate, bearing in mind that an appropriate causal connection is a necessary condition for a mental state to qualify as an episodic memory.

***Virtues of CTM.*** CTM has some *prima facie* virtues, to be sure. Werning (2020) points out three, namely: intuitive, explanatory, and taxonomical virtues. Firstly, CTM aligns nicely with how folk psychology conceptualizes remembering. Take for instance the relearning scenario mentioned above. In this scenario, because of the absence of a direct causal link, many people are likely to refuse to say that S remembers and to declare that S merely imagines having experienced the accident. If our philosophical concepts must give room

to our intuitions, then CTM has a good point. Secondly, CTM also has explanatory virtues. Take for instance the fact that our episodic memories have the role of a privileged epistemic source. For instance, a belief about an event *e* grounded on an episodic memory of *e* is generally assigned a much stronger epistemic value than a belief derived from a mere testimony about *e* (Mahr & Csibra, 2018). Appealing to an appropriate causal link smoothly explains the privileged epistemic value of the former relative to the latter, since as far as episodic memories are concerned the information that forms the content of the belief comes directly from the experience of the event the belief is about. On the face of it, CTM can also smoothly explain the ability of an episodic memory to refer to, or to be about, a particular event experienced in the past. Indeed, it can state that this particular reference relation is grounded on the particular causal connection that links the memory to the experience of the past event. Lastly, CTM also has taxonomical virtues, since it provides a criterion to distinguish between memory and imagination. Take the scenario of a veridical confabulation, in which one has an accurate imagistic representation of a past event that one has experienced while one's representation of the event is not actually due to that experience, as in Martin & Deutscher's hypnotist scenario. We will likely be reluctant to count the representation of the event as an episodic memory and will prefer to consider it as a case of imagination. The absence of a causal connection in such a scenario provides an appealing way to ground this taxonomical stand<sup>4</sup>.

**Standard CTM's transmissionist and preservationist commitments.** However appealing it might be, standard CTM has been criticized on a number of grounds, some saying that the causal condition should be revised – we can call this view “neo-causalism” (Debus, 2010; Michaelian, 2011; Perrin, 2018; Werning, 2020) – while others say that the causal condition should be squarely dropped from the definition of episodic memory – a view we can call “post-causalism” (De Brigard, 2014; Michaelian, 2016; Fernández, 2019; see Michaelian and Robins, 2018 for a review). In this paper, I explore the prospect of a proceduralist neo-causalist account of episodic memory. Before introducing this view, I shall pave the way for it by discussing STM. In order to see exactly what going beyond standard CTM means for STM, it will be useful to start by making explicit two of CTM's commitments<sup>5</sup>.

Firstly, CTM endorses transmissionism (TRANS). Let's call “endogenous” the content at retrieval that originates in the experience of the remembered event. By contrast, let's call “exogenous” the content at retrieval coming from sources distinct from the experience of the remembered event. Overall, the “exogenous-endogenous” pair thus captures two different relationships regarding content between encoding and retrieval. As we saw, according to CTM, endogenous content – in particular, as far as episodic memory is concerned, endogenous experiential content – is stored under the form of a structurally analogue memory trace through which it is transmitted from encoding to retrieval by an appropriate causal connection. Secondly, CTM

<sup>4</sup> That causalism can give us a satisfying distinction between genuine remembering and veridical confabulation is in fact a disputed issue. On this, see the ongoing debate about confabulation between simulationists and causalists (Robins, 2020b; Michaelian, 2021).

<sup>5</sup> See Michaelian and Robins, 2018, pp. 22-23 for the preservationism-transmissionism distinction.

endorses preservationism (PRES). According to CTM, the information conveyed by the content of the experience of the past event remains (more or less) the same – that is, it is preserved from encoding to retrieval. Note that TRANS does not imply PRES. For instance, it can happen that all the content of one's memory is endogenous while the different components of the content are ordered in a way that is completely different from the way they were in the past, thus conveying very different information from that acquired at encoding. In other words, TRANS is compatible with cases of content transformation. It can also happen that additional content is built into the initial content in such a way that the resulting information is very different from that initially acquired. In other words, TRANS is compatible, at least in part, with cases of content generation. Also note that conversely PRES does not imply TRANS. For instance, it can happen that using content coming from sources different from the experience of the remembered event conveys accurate information about the past experience. In other words, PRES is compatible with cases of content duplication. Now, while CTM endorses TRANS and PRES due to its notion of a structurally analogous memory trace, STM rejects them both due to its adhesion to (respectively) reliabilism and constructivism<sup>6</sup>, with reliabilism meaning that being a representation of a past experienced event produced by a well-functioning (or: reliable) cognitive system suffices for a mental state to qualify as a genuine episodic memory, and constructivism meaning that at encoding and over the whole temporal course of memory, operations occur that result in a deep transformation of the content of our memories. But what really matters for STM's move away from CTM is its rejection of TRANS. Indeed, on CTM, being necessary for a causal connection means that the very same content must be transmitted from encoding to retrieval. By arguing that for an episodic memory to occur there can be – and is often is – no transmission of content at all, STM is able to claim that it is not necessary that a causal connection be built into the definition of an episodic memory.

Given that STM's main move away from CTM consists in rejecting TRANS, in what follows I will consider the specific way STM targets TRANS. Michaelian's own elaborate version of STM (2016, 2021) draws on two distinct arguments: an anti-sufficiency argument and an anti-necessity argument. Both start from empirical premises, but in each case the premise is different: the former is grounded on the (empirically documented) constructive character of memory, the latter is grounded on the (empirically documented) similarities of remembering and imagining. Given the goal of my paper, I restrict myself to discussing the anti-necessity argument<sup>7</sup>.

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<sup>6</sup> Constructivism about memory has a relatively long history in psychology (see Bartlett, 1932 for a seminal articulation of this view). Following a standard usage, I will speak of the “constructive” character of memory to designate the processes occurring at encoding as well as during consolidation and reconsolidation that carve up the retrieved content, and of the “reconstructive” character of remembering to designate the operations that one carries out as one is remembering and producing a particular representation of an experienced past event.

<sup>7</sup> The anti-sufficiency argument is as follows: (*Empirical premise*) A large body of both neuroimaging and behavioural evidence has documented the many constructive processes that episodic memories undergo over time, from the initial stages of encoding and consolidation through to the stages of remembering and reconsolidation (see Michaelian (2011; 2016) for a detailed exposition of these

## 2.2 - STM's anti-necessity argument

STM claims to be an empirically-grounded theory of episodic memory (Michaelian, 2016), and it has been considered as such by most researchers (see for instance Craver, 2020). Now I will contend that STM is problematic precisely because of the empirical evidence on which it claims to be grounded. In a nutshell: its anti-necessity argument against TRANS relies on non-conclusive empirical evidence. In this section, I shall expose the anti-necessity argument. In the next section, I explain why on closer examination it appears problematic. Here is Michaelian's simulationist argument<sup>8</sup>:

### (1) Empirical premises

- a. (remembering-imagining similarity) A large body of both neuroimaging and behavioural evidence has shown strong similarities between episodic remembering and imagistic imagining activities, such as imagining one's personal future, imagining a counterfactual past, or imagining oneself in a hypothetical situation. These similarities suggest that episodic remembering shares its neural and cognitive underpinnings with such activities. According to the hypothesis of the constructive episodic simulation (Schacter & Addis, 2007), both episodic remembering and these other activities are underpinned by one unique neurocognitive episodic construction system.
- b. (anti-transmissionism about imagining) The same body of empirical evidence also suggests that imagistic imagining, in its various guises, consists in combining experiential elements coming from various past experiences in a single imagistic scene.

### (2) Conclusions

- a. (from 1a and 1b) Remembering consists in combining experiential elements coming from past experiences in a single remembered scene (weak anti-TRANS). In Schacter and Addis' terms: "memory is not a literal reproduction of the past, but rather is a constructive process in which bits and pieces of information from various sources are pulled together" (p. 773).

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processes). (*Conclusion*) Therefore, the constructive character of memory is a direct argument against PRES, since it implies that a significant amount of information that differs from the information originally encoded is frequently built into the content of episodic memories. Thus, the appropriate causal connection is not sufficient to account for the whole amount of the remembered content. Now the rejection of PRES due to the constructive character of episodic memories implies the rejection of TRANS as well, since per definition additional generated content cannot be transmitted from the original experience. Therefore, the constructive character of memory implies that TRANS is not sufficient either.

<sup>8</sup> Michaelian appeals to this argument when he says: "Advocates of the simulation theory [...] have motivated their preferred theory by appealing to empirical evidence for important similarities between remembering the past and imagining the future. [...] The simulation theory of memory [...] is motivated primarily by empirical evidence of important similarities between remembering the past and imagining the future, evidence that simulationists take to suggest that memory is a kind of imagination" (Michaelian, 2021, pp. 1-2).

- b. (from 1a and 1b) Since per definition imagining does not require any transmission of content, and since remembering is similar to imagining and does involve exogenous content, it seems reasonable to conceive of remembering without positing *any* transmission of content through a causal connection (strong anti-TRANS). This conceptual possibility is what motivates Michaelian's slippery slope argument (see 2016, pp. 103-104; 2021, p. 7). If one endorses a definition of episodic remembering along these lines, then a causal connection is not necessary any more.

It is worth insisting that part of the motivation for (2b) in Michaelian's simulationist anti-necessity argument is conceptual. As the distinction between (2a) and (2b) is intended to capture, what the empirical evidence on which STM draws affords, strictly speaking, is the *weakly* anti-TRANS conclusion that *some* of the content of an episodic memory can be exogenous. The step that leads from weak to *strong* anti-TRANS, namely the slipping move, is conceptual. Again, the slipping move goes from two empirical pieces of evidence – the inclusion of *some* exogenous content into remembering and the remembering-imagining similarity – to the conclusion that remembering does *not* need *any* transmitted content *at all*, while one would expect the conclusion that it does *not* need *exclusively* endogenous content. The only reason I can see for the step leading to the non-necessity conclusion is that the conceptualization of remembering as a species of imagining dispenses with positing any transmission of endogenous content. But again, this conceptual possibility is not implied by empirical data. I will even say below that the empirical data on which STM draws suggest an opposite move. If I am right, therefore, the anti-necessity claim is conceptually motivated but empirically ill-grounded. In section 3, I will argue for an empirically motivated determination of what is and what is not necessary for a mental state to qualify as an episodic memory, namely a well-documented procedural causal dependence of episodes of remembering on the past experiences they represent.

By way of illustration of my understanding of STM's analysis, take the following quote by Michaelian where he explicitly endorses the slipping move: "While simulation of a given past episode presumably *often* draws on information originating in the agent's experience of that particular episode, it will rarely draw *exclusively* on such information, and in principle it need not draw on such information *at all*" (2016, p. 103). On my reading, the last part of the quote – "*in principle* it need not draw on such information *at all*" – is not strictly motivated by the empirical evidence invoked by STM – again, the latter grounds merely weak anti-TRANS – but by the possibility of reconceptualizing remembering as a species of imagining, the detailed argument supporting this possibility being the reliabilist account of remembering. The upshot of this criticism of TRANS is, indeed, a definition of episodic remembering that dispenses with any causal connection thanks to the substitution of a reliabilist condition for the causal connection of CTM (Michaelian, 2016, p. 107). Overall, this simulationist argument leads to the following definition of an episodic memory:



- (STM) S has an episodic memory M of a particular past event *e* if and only if
  - S has a current representation R of *e*
  - R is produced by a properly functioning episodic system which aims to produce a representation of an episode belonging to S's personal past.

I now turn to the discussion of STM's criticism of CTM. Given that I intend to explore the claim that an appropriate causal connection is constitutive of episodic remembering, I will focus on the anti-necessity argument.

### 2.3 - *Discussing STM's anti-necessity argument*

**Objection from the hidden premise.** My first objection is that the anti-necessity argument draws on a hidden premise that is problematic. For this argument to hold good, it must be true – this is the hidden premise – that there is just one kind of information that can be transmitted from encoding to retrieval through an appropriate causal connection, namely content. On this argument, indeed, the imagining-remembering similarity suggests that remembering – just like imagining – is perfectly conceivable without involving any endogenous content. But STM does not consider the possibility that another type of information – procedural, for instance, as I will argue – turns out to be necessary to carry out the reconstruction involved by remembering. This is problematic since the non-necessity of endogenous content does not entail by itself the non-necessity of any kind of information. Therefore, STM's argument is pending<sup>9</sup>.

**Objection from the interpretation of empirical evidence (1).** My second objection is that the very empirical literature relative to the remembering-imagining similarities on which STM draws does not only provide reasons against CTM, but also reasons for CTM, namely for the unaddressed option mentioned by my first objection. Here are some quotes from Schacter and Addis (2007, emphasis added) that feed this objection: “several regions [...] were *significantly more active* for future relative to past events, including bilateral premotor cortex and left precuneus.” (p. 781) “The right hippocampus was *differentially engaged* by the future event task, which may reflect *the novelty of future events and/or additional relational processing required* when one must recombine disparate details into a coherent event.” (p. 782) “Notably, in all regions exhibiting significant past-future differences, future events were associated with *more activity* than past events [...]. We propose that this apparent regularity across neural regions and across studies reflects *the more intensive constructive processes* required by imagining future events relative to retrieving past events.” (p. 782)

As I read them, these excerpts acknowledge an important difference between remembering and imagining, namely the lower cognitive cost engaged

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<sup>9</sup> I expand in section 3 on the suggestion of a transmission of non-representational information.

by the former relative to the latter<sup>10</sup>. Reconstructing an event experienced in the past turn out to be cognitively easier than constructing a novel imagined one. Now, such an empirical fact lends strong support to the idea that as far as remembering is concerned, something transmitted from the past experience is operative in remembering and decreases the required cognitive cost, while as far as imagining is concerned, no such transmission occurs, hence the cognitive cost is higher. In line with this reading, I draw two conclusions from the above excerpts. First, the very same empirical literature to which STM appeals with a view to arguing against the necessity of TRANS provides empirical support for the latter claim, since it suggests that there *is* a causal dependence of the reconstruction of the representation of an event on the past experience of that event. In consequence, contrary to what Michaelian says (2021, p. 8), there *is* a “non-arbitrary reason” to resist the slippery slope argument – namely an empirical reason. Second, empirical support is given to the possibility of the transmission of a type of information different from content and, more precisely, to the claim that procedural information is transmitted, since easier processing is observed in remembering relative to imagining. I shall elaborate on this notion of procedural information in section 3.

**Objection from the empirical evidence (2).** My third objection is that the way STM tackles the issue of the relationship between remembering and perceiving is not satisfactory. STM appeals mainly to considerations about the remembering-imagining relationship to draw conclusions about the remembering-perceiving relationship. Bear in mind that STM’s argument goes like this: since remembering and imagining are very similar from the neurocognitive point of view, it seems very plausible that – just like with imagining – when one remembers an event one does not retrieve a content encoded when one was perceiving the event; as a consequence, it seems very implausible that there is a content-transmission relation from past perception to remembering. Note that the relationship between remembering and perceiving is only indirectly considered by this argument. Now, as I have shown with my first two objections, the debate between CTM and STM cannot be settled on the sole basis of empirical evidence regarding the relationship between remembering and imagining, since on second thought neurocognitive evidence also lends support to the causalist view. Therefore, on the one hand STM cannot argue as it does, and on the other hand, it would at this stage be a good argumentative policy to tackle the issue of the remembering-perceiving relationship by considering *direct* empirical investigations of this relationship. This is just what is done by many studies endorsing the sensorimotor model of memory that I will introduce in section 3.

Let me take stock. My previous criticisms of STM pave the way for a defence of a non- standard version of CTM, and thus for a different view of the

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<sup>10</sup> As a reviewer observed, one could find these results insufficient to contest STM since they merely exhibit a frequent feature – namely the relatively-low-cognitive-cost feature – not a necessary feature, as should be expected from a proper definition of episodic memory. But STM’s definition of episodic memory faces the same problem, since it probably happens that endogenous content is transmitted just as described by CTM. Furthermore, assuming one wants an empirically-grounded characterization of a mental state, one certainly has to search for characteristic features that are highly frequent instead of necessary features, as Andonovski rightly insists (2020, p. 25).

causal connection allegedly involved in episodic memories. Indeed, they all converge towards the notion of procedural information transmitted from the past experience of an event to the remembering of that event. The hypothesis explored by the next section is precisely that an embodied sensorimotor approach to this procedural information can both provide this notion with empirical support and refine it conceptually.

### 3 – A SENSORIMOTOR EMBODIED VERSION OF CAUSALISM

In this section, I will consider an embodied approach to episodic memory as a better empirically grounded alternative to STM. Although almost inexistent in philosophy<sup>11</sup> – hence the exploratory and programmatic character of the present paper – the embodied approach to episodic memory has gained important traction in cognitive neuropsychology over the past decades (see Iani, 2019 for a review). However, this literature assigns various meanings to the notion of ‘being embodied’<sup>12</sup>. In the present paper, I will consider specifically a proceduralism-inspired sensorimotor approach because of both the rich empirical data it has accumulated in recent years and of its promising implications for the CTM vs STM debate. I shall first sketch out the core elements that define this version and then I shall give my arguments for it.

#### 3.1 - Designing a sensorimotor approach to episodic memory

**Proceduralism and the sensorimotor approach to episodic memory.** Here is a significant quote that expresses the core proceduralist idea: “A particular feature of the propositionalist view that we dispute is the claim that all knowledge can be represented in the language-like symbols appropriate to a computer program (as in Newell, 1980). Indeed, Anderson (1983) among others seeks to reduce all procedural knowledge to the propositional. [...] Our proposal is to do the opposite, that is, to accommodate declarative knowledge in operationalizable terms of actions – the procedures that characterize a person's acquisition and use of knowledge” (Kolers & Roediger, 1984, p. 429)<sup>13</sup>. I suspect that the general proceduralist claim that follows from this quote can be put like this:

- (Proceduralist claim) The acquisition and use of any piece of representational information requires skillful operations, and a form of knowing-how is required for these operations to be carried out; the set of these skillful operations forms a procedural piece of information and the corresponding knowledge is procedural knowledge.

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<sup>11</sup> For rare exceptions, see Sutton and Williamson, 2014; Rowlands, 2017; Peeters and Segundo-Ortin, 2019.

<sup>12</sup> For a review of the different senses available, see Clark, 1999; Sutton and Williamson, 2014; Dijkstra and Zwaan, 2014; Peeters and Segundo-Ortin, 2019.

<sup>13</sup> Kolers and Roediger also say: “our aim is to carry forward the attempt to account for all of a person's capabilities within the framework of skills or procedures. (...) On our account (...) cognitive processes may be well accommodated in procedural terms.” (*id.*, p. 430). Others have expressed a similar view: “All knowledge is procedural” (Whittlesea, 1997, p. 215), or: “the concepts of declarative and procedural memory appear to have thinner boundaries” (Iani, 2019, p. 12).

The proceduralist claim thus proposes to “proceduralise” representational content, viz. instead of considering only representational content, it insists that the theory of memory must also consider the procedures through which this content is reconstructed as a type of information that is encoded in the past and underwrites retrieval.

In keeping with this general proceduralist claim, an important empirical literature has developed specifically about experiential imagistic content in episodic memories, the upshot of which is the “sensorimotor model of memory” (SMM)<sup>14</sup>:

- (SMM) The acquisition and use of any piece of remembered experiential representational information requires skillful operations, and a form of knowing-how is required for these operations to be carried out; the set of these operations are procedural pieces of information, and the corresponding knowledge is procedural knowledge.

Let’s refine SMM. As it stands, SMM suffers from an ambiguity. Evidently, it can support one of two views, depending on how precisely one conceives of the procedural information that is supposedly encoded and drawn upon at retrieval.

On one hand, it can be taken as the view that the imagistic *content of* an episodic memory is made up of sensorimotor components (Barsalou, 1999; Rubin, 2006) – call it SMM<sub>1</sub>. For instance, S can have the episodic memory M of pulling over to the sidewalk because a runaway car threatened to hit him. In this case, S’s motor action is a component of what M represents, in just the same way as are S’s sensory experiences of seeing the car running towards him. On this version, the sensory and the motor characters are features of the imagistic content of the reconstructed memory.

On the other hand, SMM can be taken as the view that the imagistic content of an episodic memory is *reconstructed through* motor procedures (Nilsson *et al.*, 2000; Iani, 2019)<sup>15</sup> – call it SMM<sub>2</sub>. For instance, as S episodically remembers seeing the car running towards him, S’s motor action – *e.g.*, S’s oculomotor actions and posture actions on the basis of which he perceives the past event – are not in themselves a component of what M represents, but are rather the procedures by which he carries out the reconstruction of the content of M. In other words, while sensory as well as motor information can be included in the content, this second version of SMM maintains that in an episode of remembering there is also a certain motor information – let’s call it a “procedural pattern” – that is not included into the imagistic content but on which S draws to reconstruct that content.

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<sup>14</sup> As I want to explore an embodied approach to episodic memory, I will focus on sensorimotor procedures in what follows. However, it is evident that these procedures do not exhaust the full range of procedures involved in episodic remembering – for instance, neural patterns provide another set of available procedures.

<sup>15</sup> This is clearly one of the main claims made by Kolers when he says that he wants: “to accommodate declarative knowledge in operationalizable terms of actions – the procedures that characterize a person’s acquisition and use of knowledge” (1984, p. 429). Roediger *et* colleagues speak of “an action-oriented approach to cognitive processing” (2002, p. 321).

**SMM and the CTM-STM controversy.** Let's go back to the CTM vs STM controversy. What notion of causal connection is brought into play in each version of SMM? And how does each fare with respect to STM's criticisms against CTM?

If SMM<sub>1</sub> were to be phrased in causalist terms, it would hardly avoid the criticisms that STM raises against CTM. What STM is about, indeed, is the imagistic content of episodic memories. Now, if STM is right to say that the components of the imagistic content of a memory often come from sources different from the past experienced event represented by the memory, then given that motor components are imagistic components too, there is no reason to deny that, just like sensory components, they can come from various sources. In line with this remark, I will not argue against STM when it rejects TRANS with regard to imagistic content. However, if SMM<sub>2</sub> were to be phrased in causalist terms, it would have more chance of avoiding the criticisms raised by STM against CTM. What SMM<sub>2</sub> is about, indeed, is not the sensorimotor imagistic content of episodic memories but the motor information on the basis of which the content is reconstructed. Thus, STM's criticisms of CTM do not apply straightforwardly to this information. It is therefore worth investigating whether SMM<sub>2</sub> can meet these criticisms<sup>16</sup>. To conclude this section, let's turn the more promising SMM<sub>2</sub> into a definition of episodic remembering. The resulting definition reads as follows:

- (SMM<sub>2</sub>) S has an episodic memory M of a particular past event *e* iff
  - S had an experience E of *e* in the past on the basis of a procedural pattern *p*.
  - S has now a representation M of *e*.
  - M has an appropriate causal connection to E that consists in re-enacting it at retrieval on the basis of *p*.

In what follows, I will assess how far one can argue for SMM<sub>2</sub>, suggesting that a procedural pattern that is in play while encoding a particular past experience could be the one that comes into play while remembering that experience. I will make my assessment by appealing to three series of

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<sup>16</sup> Interestingly, a reviewer raises the issue "about whether the sensorimotor approach, even in its second formulation (*i.e.* SMM<sub>2</sub>), can successfully deal with the challenge raised by the simulation theory", arguing that for it to do so, one would need to show that memory systems are dedicated to storing individual memory procedural traces for every experience we have. For reason of space, I cannot do full justice to this objection. Minimally, first I insist on the fact that in Schacter and Addis' constructive episodic simulation hypothesis information *is* stored and reused to construct simulations. Second, as I have detailed above (see section 2.3), the empirical data these authors provide strongly suggest that *procedural* information is stored. Third, grounding remembering on a neurocognitive system that also underpins cognitive operations like episodic future thought or counterfactual thought of the past leaves open the possibility that this unique system does not underpin all the aforementioned operations in exactly the same way. In other words, the unicity of the system does not exclude the specificity of its various achievements, with remembering possibly relying on the reactivation of procedural patterns.

empirical data that support this view, and will unfold the philosophical implications of each.

### 3.2 - Arguing for SMM<sub>2</sub>

**Three series of empirical data.** Let's argue first for the empirical adequacy of SMM<sub>2</sub>. To do so, I present three series of empirical data that lend support to this view.

Firstly, we saw that on closer examination, the data that STM appeals to for empirical support exhibit a procedural causal dependence of episodic memories on the past experienced events they represent, namely a benefit in terms of cognitive engagement in remembering relative to imagining. My suggestion is that the benefit which accrues here is due in part at least to the reactivation of procedural patterns during remembering<sup>17</sup>. The fact that these patterns are encoded and transmitted over time can contribute to explaining why it is easier to reconstruct the experience of a past event compared to constructing an imaginary event, for which no particular pattern is available<sup>18</sup>. If this is correct, then SMM<sub>2</sub> is well-equipped to account for the remembering-imagining dissimilarity under consideration, and it turns out to be supported by the very empirical data that were supposed to weaken causalism.

Secondly, SMM<sub>2</sub> also finds significant empirical support in the notion that perceptual experience crucially involves motor activity from the perceiving subject, as is claimed by the sensorimotor approach to visual perception (O'Regan and Noë, 2001; Noë, 2004). On this view, perceptual experience does not result from a passive impingement of the surrounding world on the sensory system. Rather, it results from an active motor exploration carried out by the body. Perception is "enacted" through the sensorimotor coupling between the body and its environment. More specifically, any perceptual state is underpinned by bodily postures and actions to the effect that being in such a state requires knowing to which bodily posture or action it is correlated. By this knowledge, a merely sensory state acquires its representational content. For instance, for S to apprehend a visual sensation as the perception of a certain aspect of an object, S must not only apprehend the visual sensation procured by the object, but he must also know that the sensation is correlated with a certain position with respect to the object; together with certain other possible sensorimotor correlations, like the visual sensations he would enjoy if he moved from his current position to another one by moving around the object. According to O'Regan and Noë, the knowledge of these correlations – which they call "knowledge of sensorimotor contingencies" (O'Regan & Noë, 2001) – is "implicit" and "practical" rather than a piece of representational information, and is constantly reiterated during the episode of perceiving. My suggestion is that SMM<sub>2</sub>'s notion of "sensorimotor" is closely similar to

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<sup>17</sup> Again, obviously other non-motor procedures also are executed and involved in remembering.

<sup>18</sup> A general worry raised by a reviewer concerns the very possibility for procedural information as understood in this paper to be encoded and retrieved. I endorse a positive view on this point by invoking the empirical data that exhibit that ways of doing – in particular, motor skills – are encoded and retrieved with no obvious non-procedural information underlying them. But it is a controversial view. For a recent discussion, see De Brigard, 2019.

O'Regan and Noë's notion on two important counts. First, both concern the motor actions – procedural patterns – required for a sensory experience to be apprehended as representing an event<sup>19</sup>. Moreover, both consider that these actions form implicit practical knowledge available to the experiencing subject, with O'Regan and Noë pointing out the role of this knowledge in perception and SMM<sub>2</sub> pointing out its role in remembering. In line with this, I propose to say that the sensorimotor approach to visual perception mainly concerns the role of procedural information at the encoding of episodic memories, while SMM<sub>2</sub> is mainly concerned with its role at retrieval. This outlines an enactivist sensorimotor approach to remembering that I will flesh out in the following paragraphs.

Last, a notably well-developed series of data provides direct and detailed support for the notion of a particular procedural causal dependence of remembering on past experience. It is part of a wider view on which motor patterns encoded during past experience are reactivated during retrieval (Nilsson *et al.*, 2000; Nyberg *et al.*, 2001) – the so-called “reactivation hypothesis” (see Slotnick, 2017) – and it shows that the gaze movements carried out as an event *e* is experienced and a perceptual experience *E* occurs are replayed as the memory *M* of *e* occurs and are functional to the reconstruction of the imagistic content intrinsic to *M* (Laeng & Teoderescu, 2002; Mäntylä & Holm, 2006; Kent & Lamberts, 2008; Johansson *et al.*, 2012; Olsen *et al.*, 2014; Laeng *et al.*, 2014; Johansson & Johansson, 2014; Bochynska & Laeng, 2015)<sup>20</sup>. Typically, two parameters are tested by these studies: the way in which the eyes fix on the different elements of the scene apparent in the experienced event, and the sequential order of these fixations, which forms the scan pathway followed by the gaze as it explores the scene. Let's consider an example of such studies.

Laeng *et al.* (2014) report three experiments in which the participants first visually inspected a stimulus and were later asked to retrieve it through mental imagery. The gaze was monitored both at encoding and at retrieval in different conditions. Here are some details and interesting results. In their second experiment, subjects were presented with pictures of animals and were later asked, while looking at an empty grey screen (“looking at nothing” condition) to recall the animal in an imagistic way. They found that eye movements at recall substantially overlapped those used to scan the objects in the initial phase of the study, with this overlap being relatively fine-grained since encoding and retrieval were similar with respect not only to the part of the visual space where the gaze dwelled, but also to the most defining and salient features of the particular objects that formed the scene – for instance, the gaze dwelt more on the head of a deer than on its legs. Moreover, and most importantly, such an overlap predicted accuracy in memory tasks in that those participants who reenacted eye movements during recall more closely resembling the original movements also showed higher scores in spatial memory tasks. “[...] we found a strong correlation between a participant's

<sup>19</sup> Sensory and motor are thus not two components of the perceptual content. Instead, the latter is what turns the former into perceptual content.

<sup>20</sup> Though less studied, other motor patterns – such as gesture patterns, body posture patterns – have been documented and are potential empirical arguments for SMM<sub>2</sub>.

enactment fidelity and accuracy of spatial memory”, note Laeng and colleagues (2014, p. 272)<sup>21</sup>. In their third experiment, several conditions were used in order to show that “controlling the gaze during imagery can disrupt memory performance” (p. 273). In particular, in one condition subjects’ gaze was fixed on a location point distant from the original fixations. Interestingly, memory performance significantly decreased when gaze during recall was forced to remain on this fixation point. Therefore, interfering with gaze during recall seems to decrease the quality of the memory.

This pattern of results has been replicated by multiple experiments. For instance, in an episodic memory task concerning visual scenes, Johansson and Johansson (2014) also found that a central fixation constraint perturbed retrieval performance by increasing reaction times needed for recalling such events, and that memory retrieval was facilitated when eye movements were manipulated toward parts of a blank area that was congruent with the original location of the object to be recalled. These results were also robust with respect to memory accuracy. Based on these data, Johansson and Johansson claim that: “remembering involves the reinstatement of the processes that were active during encoding, and the chance of remembering is best when the processes engaged by a retrieval cue overlap with those engaged at encoding” (pp. 1-2). Iani notes too: “These results seem to suggest that there is a high gaze pattern correlation between perception and recall” (2019, p. 5). In sum, there is a growing amount of empirical evidence for strong correlations between bodily postures and motor actions – in particular eye movements<sup>22</sup> – at encoding and retrieval, and most importantly, that these postures and motor actions are strongly functional at retrieval, and in particular with respect to the accuracy of our memories.

*A necessary dependence of episodic memories on procedural patterns.* As the above data illustrate, the accuracy of episodic recollections appears to be strongly causally dependent on the re-enactment of the procedural pattern used at encoding. The data comply with two standard requirements for a causal dependence to occur<sup>23</sup>. The previous empirical data allow us to say on the one hand that – all things being equal – if there is re-enactment of the original procedural pattern, then there is accurate memory. It also allows us to say, on the other hand, that if the procedural pattern is not re-enacted – as in the condition in which the gaze is constrained to fix a location point distant from the original fixations – then the accuracy is diminished. Procedural pattern re-enactment is thus a causal condition for accuracy of memory and, as far as empirical studies can say, a necessary one since its absence implies

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<sup>21</sup> I elaborate below on the importance of this point.

<sup>22</sup> For studies demonstrating the influence of other motor parameters in remembering, see Wesp, Hesse, Keutmann, & Wheaton, 2001; Stevanoni & Salmon, 2005; Iani, Cutica & Bucciarelli, 2016; Iani & Bucciarelli, 2018.

<sup>23</sup> Here I draw on the broad and widely endorsed characterization of causality as a relation of dependence of the occurrence of an effect on the occurrence of its cause, which could be fleshed out in counterfactual terms (see Lewis, 1973) as well as in probabilistic terms (see Hitchcock, 2016). Since my analysis does not depend on the specific view one has about causality, I will not pursue this point here.



inaccuracy<sup>24</sup>. Since, arguably, accuracy is the distinctive condition for a memory to be successful, then procedural pattern re-enactment is a necessary causal condition for successful remembering.

Three comments will refine this point. Firstly, note that the causal dependence under consideration cannot be explained in terms of a generic procedural pattern that would derive from a set of closely similar particular experiences. Indeed, some of the experimental designs mentioned were cautious about using a sufficiently fine-grained material to avoid the interference of generic patterns and to secure particularity. For instance, the re-enactment was observed for the vision of an animal in a particular posture rather than for a standard posture of the animal (Laeng *et al.*, 2014, p. 273). Overall, causal dependence on procedural patterns holds for the mnemonic representation of particular scenes, which suggests that what is transmitted is particular patterns. If this is on the right track, then the particular causal connection of procedural patterns is necessary for successful remembering. Secondly, the objection could be made that the analysis given above only concerns visual imagistic information, which is crucial for but not exhaustive of episodic memory. After all, episodic memories also have auditory or emotional components, and evidently it is far from obvious that a sensorimotor account could do justice to them. *A fortiori*, the objection could continue, the sensorimotor approach under consideration has nothing to say of non-imagistic components of episodic memories – for instance, semantic components – while it is arguable that episodic memories involves such components. My reply is that, despite motor re-enactment being about one particular aspect of episodic memories, it concerns a core component of any successful remembering. Thus, though SMM<sub>2</sub> does not claim to account for all the components of an episodic memory, it still provides an argument for the necessity of a causal connection for a core component of episodic memory. Last, the causal dependence claim is a straightforward argument against STM's account of successful episodic memories. In line with its definition of episodic memory<sup>25</sup>, STM maintains that an episodic memory is successful if (and only if) it is an accurate representation R of *e* produced by a properly functioning (or: reliable) episodic system. If I am right, the previous empirical data and the causal dependence they exhibit show that a further condition is necessary, namely the transmission of procedural patterns. Note that by saying this I am not arguing against the *conceptual* possibility of accounting for successful remembering by using the sole notions of accuracy and reliability. In line with my remarks in section 2, I am arguing against the empirical adequacy of STM's account, and I insist on the fact that conceptual possibility is not sufficient to reject the claim that a causal connection is necessary.

***Qualifying the philosophical implications.*** In keeping with the exploratory and qualified stand of this paper, two caveats must be added regarding the data on which I have grounded the SMM<sub>2</sub> claim of a necessary causal dependence.

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<sup>24</sup> It has been observed that accuracy is dependent on both the points of fixation (Laeng *et al.*, 2014, p. 265; Johansson and Johansson, 2014) and on the path of the gaze (Bochynska & Laeng, 2015) at encoding. Again, see Iani (2019, p. 4) for a review.

<sup>25</sup> See section 2.2.

The first caveat is about the notion of a degree of similarity of the procedural pattern as it is re-enacted relative to the procedural pattern carried out at encoding. People advocating proceduralism in cognitive psychology are eager to point out that there is no exact similarity here. For instance, according to Laeng and colleagues, the pattern of eye movement “does not necessarily recapitulate all processing that occurred during encoding [...] that forming a mental image does not re-enact all aspects of what the participants did at the time of encoding. [...] According to an enactivist account, if imagery uses eye positions as a scaffolding structure for generating a detailed image, then the pattern of gaze during imagery can be based on a subset of the original movements (*viz.*, relevant gaze pointers; cf. Ballard *et al.*, 1997) and it should actually tend to resemble the structure of the imagined object more than being a faithful repetition, in its minute details, of what gaze actually did during the original perceptual episode or encoding” (2014, p. 276). Re-enactment of procedural patterns is thus not about strict identity, but about close similarity. However, many causalist accounts on the philosophical side already endorse the notion of a close similarity (Michaelian, 2011; Werning, 2020, p. 307 for a detailed analysis of this notion). Though a precise specification of what “close” means can be difficult to give, the qualification should thus not be problematic for SMM<sub>2</sub>.

More importantly, the second caveat is about the very notion of episodic memory. An important pending issue at this stage is indeed whether SMM<sub>2</sub> and STM are really talking about the same thing and not talking past each other<sup>26</sup>. Indeed, the direct empirical evidence that I have just mentioned documents patterns of results for periods of time ranging from some milliseconds (Laeng *et al.*, 2014) to one week (Martarelli and Mast, 2013), passing through to 15 minutes (Laeng *et al.*, 2014) and 48 hours (Bochynska & Laeng, 2015). Pointing out the relative briefness of this lapse of time, STM could object that by “episodic memory” it means memories occurring a much longer lapse of time after the experience they represent – namely, months or years later – rather than the comparatively recent memories tested by the aforementioned experiments. In other words, while SMM<sub>2</sub> captures causal relations for a form of memory definitely distinct from working memory, *viz.* episodic memories – procedural patterns observed at retrieval are not the mere maintenance over a very short period of time of an occurrence of these patterns – it does not provide evidence for long periods of time either, whereas STM’s anti-necessity objection against TRANS is about such old episodic memories. If TRANS proves unnecessary for these memories, then STM can conclude that a causal connection is not necessary for episodic memories.

I see two options on the table at this stage. Let’s call them the optimistic and the longitudinal options. On the optimistic option, what SMM<sub>2</sub> documents about recent episodic memories should be in principle replicable for old episodic memories. STM could object that the constructive character of memory renders very implausible the transmission of particular procedural patterns over long period of times. But on the one hand, we do not have the data needed to ground any of the optimistic or the simulationist claims, though

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<sup>26</sup> Thanks to Kirk Michaelian for helpful discussions on this point.

recent studies have started to explore this topic (see El Haj *et al.*, 2020). More empirical work is definitely needed here. On the other hand, empirical studies suggest that what determines the number of constructive processes to which a memory has been submitted is not the temporal distance between it and the experience it represents, but the amount of times it has been retrieved, with each retrieval being an occasion of modification and reshaping. Consequently, being old for a memory does *not* exclude entertaining a particular causal relation to the past, and if the notion of procedural patterns is promising, being old for a memory does not exclude entertaining a particular *procedural* causal relation to the past. Now, on the alternative longitudinal option, even if STM turned out to be right about highly constructed episodic memories, yet SMM<sub>2</sub> could still say that it captures a causal connection for a specific way for episodic memories to evolve in time. In other words, on the longitudinal suggestion, a satisfying theory of episodic memory should allow for a distinction between different time courses in the dynamic existence of an episodic memory, with causalism under the form of SMM<sub>2</sub> being the correct theory regarding relatively lightly constructed episodic memories and STM the correct theory regarding relatively highly constructed episodic memories. Furthermore, drawing on the same longitudinal approach, SMM<sub>2</sub> could even say that STM concerns cases of imagination – that is, cases of memories that are so strongly constructed and reshaped that they present us with imaginings of the past – but it could also say that, as noted above, there are also old *memories*, namely memories that are relatively lightly constructed, which accordingly still entertain a particular causal relation to the past. Overall, and though I cannot pursue these suggestions here, they pave the way for a potential defence of causalism against STM<sup>27</sup>.

#### 4 – CONCLUSION

What are we left with? With a picture that is mixed, to be sure, but nonetheless interesting. On the one hand, my argument for a sensorimotor approach to episodic memory is intended to qualify the claim that episodic memories are embodied, and thereby to specify more tightly than is the case in the extant literature what a reasonable application of the embodied cognition framework to episodic memory might look like. As it turns out, this claim holds good for visual imagistic content, but this success is less clear for other imagistic components, and still less clear for the semantic component of our episodic memories. Moreover, the embodied claim is empirically well-supported for relatively recent episodic memories, but we lack empirical data as far as old episodic memories are concerned. Despite these limitations, we

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<sup>27</sup> An objection that could come to the reader's mind is that even if one accepts that particular transmission is secured, there is still the question of whether this is sufficient to account for the particularity of the reference to the event experienced in the past. After all, a mental image proceeding from a reconstruction based on a particular procedural pattern does not determine by itself whether it refers to an iterative past experienced event or to a particular one. My reply is that the sensorimotor approach I have developed in this paper argues for the *necessity* of TRANS, not for its sufficiency, in line with the task I have set to myself. Thus, the objection is off the point. Another possible reply is that in fact the reference of most of our episodic memories is not to particular (singular) but to iterative experienced events (see Andonovski, 2020), and thus that here there is nothing about their reference that could be objected against SMM<sub>2</sub>.

have a case for a necessary particular causal connection regarding a major component of episodic memory (visual imagistic content), and thus we have an argument for TRANS, which is the main target of STM as it argues against CTM. If this is right, then we should give serious consideration to a sensorimotor version of CTM.

Assuming that the proposed sensorimotor approach is on the right track, then some prospects for future research can be suggested. I favour two by way of a final speculation. A first prospect is about the *phenomenology of remembering*, for which an embodied approach seems to be a hopeful option. Perrin and colleagues (2020) have recently argued for an embodied view about the feeling-of-pastness component of phenomenology, and empirical data suggest that the experience of reliving in episodic remembering is due to the imagistic sensorimotor content of the memory (Iani, 2019, p. 15). An option that thus recommends itself is then to flesh out this dual phenomenology (Dokic & Martin, 2015) in terms of a two-tiered embodied approach on which one core phenomenological component is the result of the sensorimotor imagistic content of the memory, and the other is the result of the procedures – in particular motor procedures – on the basis of which the imagistic content is reconstructed as one remembers. A second prospect is about the *generation of content* exhibited by a great many episodic memories, a feature that has been pointed out by STM as a potential difficulty for proceduralism (Michaelian & Robins, 2018) and that I have set aside in this paper since it is distinct from the necessity claim of CTM's transmissionism. A final speculation is that not only does SMM<sub>2</sub> have no problem with the idea of additional content since it argues for the necessity of TRANS and not for its sufficiency, but it can also nicely accommodate certain generative features of episodic memories. Take for instance the schematic character of the content of memories as illustrated by the superportrait phenomenon in which subjects recognize caricatures faster than they recognize faithful portraits (Rhodes, 1997; Koriat *et al.*, 2000). Evidently, recognizing a face involves a certain visual scan pathway. The superportrait phenomenon could then be explained by the fact that though they are initially fine-grained, procedural patterns operative in retrieval tend to schematize over time and emphasize the main features of the pathway. I offer these two prospects for future research.

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