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Memory and feeling of pastness

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ABSTRACT

The aim of this paper is to provide an answer to the following question: How is it that content that is produced in the present can be attributed to the past? According to behavioral data and the active inference framework, we have developed the idea that the feeling of pastness is rooted in both an attribution process and an inference that originates from the phenomenological feeling accompanying any cognitive processing. More precisely, we propose that the feeling of pastness arises from an inference made to resolve the perception of a change in the phenomenological experience or fluency associated with the ongoing process, even when this process is not directly related to the stimulus being judged.

KEYWORDS

Feeling of pastness,
Fluency,
Attribution process,
Active inference.

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Over the last 20 years, a significant number of studies have shown that our memories, far from being a simple retrieval of stored experiences, are actually reconstructions of these experiences. More precisely, our memories are enacted: they emerge from the actions we perform in the retrieval situation (Hutto &Peeters, 2018; Brouillet, 2020; Caravà, 2023). Consequently, if it is widely accepted that the past influences the present, it becomes evident that the present shapes the past. This is because the past is always narrated in the present, and this narration must be consistent with the present. To paraphrase Neisser (1996), memories are a reflection of the ongoing dynamics of cognition in the here and now; they emerge from these dynamics. But how, then, do we attribute the product of this dynamic to the past?

The attribution processes.

To our knowledge, only the SCAPE model (Selective Construction And Preservation of Experience) proposed by Whittlesea (1997) has laid the foundation for understanding how a here-and-now construction can be attributed to the past. SCAPE's major contribution is its proposition that the feeling of familiarity, which allows us to identify a stimulus as old (i.e., a memory), is the result of an attribution process arising from inference.

For SCAPE, the feeling of familiarity doesn't depend on the historicity of the stimulus (i.e., whether it has been encoded and stored) but emerges from two components of the cognitive dynamic related to the situation: a) the construction of a mental model based on interactions between current and previous experiences; b) the occurrence of a subjective feeling associated with the evaluation of the "quality" of the processes involved in constructing this mental model and the expectations linked to this evaluation. The quality of the process corresponds to what is called "fluency," defined as the subjective experience of the ease with which our own cognitive processes proceed (see Alter & Oppenheimer, 2009; Reber& Schwarz, 2001).

However, fluency is phenomenologically transparent to its own causal source, meaning it doesn't represent that source (it's merely a subjective feeling, Metzinger, 2003). This is why attributing it to a source relies on an attributional process (the fluency attribution heuristic, Jacoby & Dallas, 1981). This attributional process is based on inference: if fluency is felt, its origin can only be what I am aware of—the processed stimulus. Consequently, the evaluation of the "quality" of the process directs attention to the ongoing process, and depending on the nature of the task, this attention to the conscious stimulus will have consequences for tasks such as distance judgment (Alter & Oppenheimer, 2008), memory judgment (Lanska, Olds&Westerman, 2014), spatial attention (Turo, Collin &Brouillet, 2022), hedonic judgment (Reber, Winkielman& Schwarz, 1998), and aesthetic judgment (Reber, Schwarz &Winkielman, 2004).

As the SCAPE model has pointed out, the evaluation of the mental model under construction is not only about the quality of the process but also about expectations. Whittlesea and his colleagues (Leboe-McGowan & Whittlesea, 2013; Whittlesea &Leboe, 2000, 2003; Whittlesea & Williams, 1998, 2000, 2001a, 2001b) have shown that a violation of expectations and consequent surprise results in an attribution of the felt fluency to the stimulus being processed, as if it had been previously encountered (referred to as the Discrepancy Attribution Hypothesis). For example, they observed that a regular non-word like "hension" is more easily recognized than a regular word like "table" when people are asked to pronounce both. The explanation provided by the authors is as follows: when the regular non-word appears, it is difficult to identify it as part of the vocabulary. However, when you have to pronounce it, you experience a certain ease in doing so (which would not be the case for a non-regular non-word like "stofwus"). The discrepancy between perceived non-fluency (the spelling of the regular non-word) and perceived fluency (pronounceability) focuses attention on the processing in progress, pronouncing the regular non-word. Fluency linked to pronounce ability relative to perceptual non-fluency leads individuals to attribute the regular non-word to the past and consequently recognize it as having been encountered before. Following this inferential principle: if it is fluent, then it is not new. So, "… extra-fluent processing is (simply) experienced as a feeling of familiarity" (Whittlesea, 1997, p. 244).

Recently, Brouillet et al. (2023) observed similar results with the manipulation of visual fluency and conceptual fluency: when there is a discrepancy between conceptual and perceptual fluency, false recognitions are more frequent than when there is a match between conceptual and perceptual fluency. However, in all experiments demonstrating the discrepancy effect, fluency was directly associated with word processing. Brouillet, Milhau, Brouillet, and Servajean (2017) wanted to know whether felt fluency associated with the action performed, independently of word processing, produced the same effects. For this purpose, they tested the discrepancy hypothesis through the effect of motor fluency (i.e., a gesture performed with the dominant hand and in ipsilateral gesture) that preceded the words to be recognized. It should be noted that the gesture had no relationship with the meaning of the words. The results indicates that participants made more false recognitions of new words (unlearning words) after a fluent gesture than after a non-fluent gesture. The discrepancy between motor fluency and non-fluency associated with new words can explain these results. Finally, Brouillet, Rousset, and Perrin (2022) showed an effect of discrepancy through the transfer of the motor fluency associated with past interactions with the environment, regardless of the stimulus in progress.

Taken together, these results demonstrate that the cognitive system is sensitive to the discrepancy between what is felt: felt fluency (e.g., pronounceability for Whittlesea's experiments or ipsilateral gestures for Brouillet's experiments) and unfelt fluency (e.g., non-pronounceability for Whittlesea's experiments or new words for Brouillet's experiments). This discrepancy generates a non-specific signal that automatically triggers the search for an explanation, resulting in the orientation of attention toward processing the current sensory inputs. Since participants cannot attribute this nonspecific signal to its source, they attribute it to the most salient source—the stimulus, and in a memory task, they recognize it. Consequently, the feeling of pastness is nothing more than an inference underlined by non-conscious subjective feeling.

The inferential processes

The concept that cognitive processes are inferential processes was originally proposed by Hermann von Helmholtz (1867) and has been further developed within the context of the Active Inference framework, which is a formulation of Predictive Processing (PP) applied to the perceptual, cognitive, and enactive functioning of the brain (for a comprehensive review, please refer to Parr, Pezzulo& Friston, 2022).

The Active Inference framework explains the major characteristics of living systems, particularly their ability to maintain homeostatic balance. This involves minimizing the discrepancy between current sensations and predictions based on previously assimilated information within a generative model of the world. Importantly, the process of reducing this discrepancy is not passive; living systems actively control the environment they perceive, hence the term 'Active Inference.'

Active Inference places a strong emphasis on how the brain hierarchically constructs a predictive model of the causes of its sensations. The cortical hierarchy involves top-down predictions and bottom-up prediction errors, which are used to update the predictive model and the synaptic weights encoding causal regularities of the world. In essence, our brain serves as an internal model of the world (i.e., the body/environment system), seeking to predict sensory inputs and their causes to reduce uncertainty and minimize prediction errors between sensations and predictions (Friston, 2010; Friston & Stephan, 2007; Friston, Thornton, & Clark, 2012).

Active Inference illustrates how all living organisms reduce the gap between predicted and observed outcomes through the perception-action loop. Prediction errors can be minimized in two ways: by revising beliefs or representations of the causes of sensations to produce more accurate predictions (as in perception) or by generating sensations through actions on the world that align with predictions. In this context, perception and action are seen as the means by which all living organisms reduce prediction errors. However, it is not just a question of reducing prediction errors, but of reducing errors that convey accurate information relevant to updating of beliefs or representations. What matters is the accuracy of the predictions or, more precisely, the estimate of prediction accuracy.

From a neurophysiological perspective, sensitivity to prediction errors is thought to be mediated by neurons with dendritic compartments, where prediction errors are computed through local voltage dynamics in the dendrites (for moredetails, see Mikulasch et al., 2023). From a psychological standpoint, sensitivity to prediction errors can be understood in terms of selection, specifically attentional selection.

To assess the precision of its predictions, the brain relies on its own beliefs. Our brain must recognize the precision of its predictions or, at the very least, their accuracy. Recently, Brouillet and Friston (2023) have argued that fluency, the subjective experience associated with all cognitive processing, is a product of this recognition process. In this context, fluency plays a pivotal role in prediction, as it reflects or enables the recognition of the accuracy of predictions and, consequently, underpins the accurate updating of beliefs. However, according to the authors, it is not fluency itself that is primarily perceived, but rather changes in the expectation of fluency. These changes initiate the attentional system, directing attention to the ongoing process and providing meaning to the experienced fluency. In other words, the authors have highlighted a close relationship between hierarchical predictive processing, particularly precision, fluency, and attention during active engagement with the sensorium.

Feeling of pastness as an active inference

We believe that the framework of Active Inference, when integrated with the concept of fluency, allows us to understand how a mental model constructed in the present can be perceived as coming from the past. In other words, it helps explain how the feeling of pastness arises.

In line with Whittlesea's work, the studies described in the first chapter emphasize the crucial role of discrepancy in cognitive processing. Discrepancy is a warning signal that indicates a gap between what is observed and what was predicted. Consequently, it prompts a redirection of attention towards ongoing processes and the associated feeling of fluency. Since fluency is transparent in terms of its causal source, it is attributed to the processed stimulus. This means that the inference is linked to stimuli, in this case, words. However, the studies by Brouillet et al. (2017, 2022), we have reviewed, mainly demonstrate is that fluency operates, i.e., recognition occurs, even when its origin is not the stimulus being processed. It is in this context that we consider the Active Inference framework can explain why stimuli are recognized (e.g., the feeling of pastness for new words), even if the felt fluency is not associated with the stimulus being processed.

As Brouillet and Friston (2023) point out, to feel fluency is to recognize fluency, meaning to infer that the unfolding of the processes generating our sensations is not surprising. More precisely, they propose that what is recognized are changes in fluency or surprise, transitioning from unfelt to felt or from felt to unfelt. It is important to note that in this context, surprise should not be viewed as a mental state but rather an attribute of sensations (self-information, Levy, 2008; Tribus, 1961) as it triggers a shift in attention. Thus, surprise represents the non-conscious recognition of a change in the attentional field, in particular the recognition that our attention is drawn to something we did not predict. Consequently, surprise is recognized as unfelt fluency or prediction error.

The mental process that accompanies the recognition of surprise is analogous to inferential attribution or active inference: finding a cause or reducing prediction error. Thus, the felt fluency is essentially an expression of the optimization of the inferential process, reflecting the phenomenological experience of the precision of the ongoing processing — a solution to the problem arising from the subjective experience of an unexplained change. Therefore, the accuracy of the process in progress and the associated fluency do not necessarily need to relate to the stimulus under judgment.

As we discussed earlier, to assess the accuracy of its predictions, the brain relies on its own beliefs. When memory is involved, there is a well-established belief that has been experienced many times: encountering a stimulus previously makes it easier to process if encountered again. Thus, as Kelley and Jacoby (1990) put it, "fluency is a reliable cue to the past because past experience does facilitate present re-experience" (p. 54).

Conclusion

The aim of this paper was to provide an explanation, based on both the Discrepancy Attribution Hypothesis and the Active Inference framework, for why a mental model created in the present can be associated with the past. We proposed that the feeling of pastness arises from an inference made to resolve the perception of a change in the phenomenological experience or fluency associated with the ongoing process, even if this process is not directly related to the judgedstimulus. This has led us to argue that the felt fluency, which gives rise to the feeling of pastness, is nothing other than the expression of the optimization of the inferential process, which originates in unfelt fluency (prediction error).

It could be objected that this inferential process can lead to the false recognition of words that have not been learned, as demonstrated in the experimental works we have presented. From an adaptive point of view, falsely recognizing a stimulus that is not present is often less detrimental than not recognizing a stimulus that is indeed present. From the previous sentence, consider changing "stimulus" with a specific context such as "predator”, which would give: “falsely recognizing a predator that is not present is often less damaging than not recognizing a predator that is actually present”.

References

Alter, A. L., & Oppenheimer, D. M. (2008). Effects of fluency on psychological distance and mental construal (or why New York is a large city, but New York is a civilized jungle). *Psychological Science*, *19*(2), 161-167. https://doi.org/10.1111/j.1467-9280.2008.02062.x

Alter, A. L., & Oppenheimer, D. M. (2009). Uniting the tribes of fluency to form a metacognitive nation. *Personality and social psychology review*, *13*(3), 219-235. https://doi.org/10.1177/1088868309341564

Brouillet, D. (2020). Enactive memory. *Frontiers in psychology*, *11*, 114.

Brouillet, D., & Friston, K. (2023). Relative fluency (unfelt vs felt) in active inference. *Consciousness and Cognition*, *115*, 103579.

Brouillet, D., Milhau, A., Brouillet, T., &Servajean, P. (2017). Effect of an unrelated fluent action on word recognition: A case of motor discrepancy. *Psychonomic bulletin & review*, *24*(3), 894-900. https://doi.org/10.3758/s13423-016-1160-0

Brouillet, D., Servajean, P., Gimenez, C., Turo, S. &Michalland, A.H. (2023). The subjective feeling of a gap between conceptual and perceptual fluency is interpreted as a metacognitive signal of pastness. *Cognitive Processing*, 24, 83-94. https://doi.org/10.1007/s10339-022-01114-0

Brouillet, D., Rousset, S. & Perrin, D. (2022). Experience of memory: transfer of the motor feeling of fluency linked to our interaction with the environment. *Psychological Research*. https://doi.org/10.1007/s00426-022-01759-8

Caravà, M. (2023). Enactive memory. In, L. Bietti& P. Martin (eds.), *The Palgrave Encyclopedia of Memory Studies*. London: Palgrave Macmillan. pp. 1-8.

Friston, K. (2010). The free-energy principle: a unified brain theory?.*Nature reviews neuroscience*, *11*(2), 127-138. https://doi.org/10.1038/nrn2787

Friston, K. J., & Stephan, K. E. (2007). Free-energy and the brain. *Synthese*, *159*(3), 417-458. https://doi.org/10.1007/s11229-007-9237-y

Friston, K., Thornton, C., & Clark, A. (2012). Free-energy minimization and the dark-room problem. *Frontiers in psychology*, 130. https://doi.org/10.3389/fpsyg.2012.00130

Hutto, D. D., &Peeters, A. (2018). The roots of remembering: Radically enactive recollecting. In K. Michaelian, D. Debus and D. Perrin (Eds) *New directions in the philosophy of memory* (pp. 97-118). Routledge. https://doi.org/10.4324/9781315159591

Jacoby, L. L., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General*, *110*(3), 306. https://doi.org/10.1037/0096-3445.110.3.306

Kelley, C. M., & Jacoby, L. L. (1990). The Construction of Subjective Experience: Memory Attributions. *Mind & Language*, *5,* 1, 49-68. Doi/ 10.1111/j.1468-0017.1990.tb00152.x

Lanska, M., Olds, J. M., & Westerman, D. L. (2014). Fluency effects in recognition memory: Are perceptual fluency and conceptual fluency interchangeable?.*Journal of Experimental Psychology: Learning, Memory, and Cognition*, *40*(1), 1. https://doi.org/10.1037/a0034309

Levy, R. (2008). Expectation-based syntactic comprehension. *Cognition*, *106*, 1126-1177. https://doi.org/10.1016/j.cognition.2007.05.006

Metzinger, T. (2003). Phenomenal transparency and cognitive self-reference. *Phenomenology and the Cognitive Sciences, 2,* 353-393.

Mikulasch, F. A., Rudelt, L., Wibral, M., &Priesemann, V. (2023). Where is the error? Hierarchical predictive coding through dendritic error computation. *Trends in Neurosciences*, *46*(1), 45-59. https://doi.org/10.1016/j.tins.2022.09.007

Neisser, U. (1996). Remembering as doing. *Behavioral and Brain Sciences*, *19*(2), 203-204.

Parr, T., Pezzulo, G. & Friston, K.J. (2022). *Active Inference: The Free Energy Principle in Mind, Brain, and Behavior*. MIT Press, Cambridge.

Reber, R., & Schwarz, N. (2001). The hot fringes of consciousness: Perceptual fluency and affect. *Consciousness & emotion*, *2*(2), 223-231. https://doi.org/10.1075/ce.2.2.03reb

Reber, R., Schwarz, N., &Winkielman, P. (2004). Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience?.*Personality and social psychology review*, *8*(4), 364-382. https://doi.org/10.1207/s15327957pspr0804

Reber, R., Winkielman, P., and Schwarz, N. (1998). Effects of perceptual fluency on affective judgments. Psychological. Science. 9, 45–48. https://www.jstor.org/stable/40063245

Tribus, M. (1961). *Thermodynamics and Thermostatics: An Introduction to Energy, Information and States of Matter, with Engineering Applications*. D. Van Nostrand Company Inc, New York, USA.

Turo, S., Collin, F., &Brouillet, D. (2022). When the sense of fluency triggers an attentional bias. *Quarterly Journal of Experimental Psychology, 76, 2, 350-360.* https://doi.org/10.1177/17470218221086185 von Helmholtz, H. L. F. (1867). *Optique physiologique*. Trad. E. Javal et N.TH. Klein, Masson, Paris.

Whittlesea, B. W. (1997). Production, evaluation, and preservation of experiences: Constructive processing in remembering and performance tasks. In D. L. Medin (Ed.), *The psychology of learning and motivation: Advances in research and theory*, Vol. 37, pp. 211-264). Academic Press.

Whittlesea, B. W., &Leboe, J. P. (2000). The heuristic basis of remembering and classification: Fluency, generation, and resemblance. *Journal of Experimental Psychology: General*, *129*(1), 84. https://doi.org/10.1037/0096-3445.129.1.84

Whittlesea, B. W., &Leboe, J. P. (2003). Two fluency heuristics (and how to tell them apart). *Journal of Memory and Language*, *49*(1), 62-79. https://doi.org/10.1016/S0749-596X(03)00009-3

Whittlesea, B. W., & Williams, L. D. (1998). Why do strangers feel familiar, but friends don't? A discrepancy-attribution account of feelings of familiarity. *Acta psychologica*, *98*(2-3), 141-165. https://doi.org/10.1016/S0001-6918(97)00040-1

Whittlesea, B. W., & Williams, L. D. (2000). The source of feelings of familiarity: the discrepancy-attribution hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *26*(3), 547. https://doi.org/10.1037/0278-7393.26.3.547

Whittlesea, B. W., & Williams, L. D. (2001a). The discrepancy-attribution hypothesis: I. The heuristic basis of feelings and familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*(1), 3. https://doi.org/10.1037/0278-7393.27.1.3

Whittlesea, B. W., & Williams, L. D. (2001b). The discrepancy-attribution hypothesis: II. Expectation, uncertainty, surprise, and feelings of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *27*(1), 14. https://doi.org/10.1037/0278-7393.27.1.14