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Case History

**The persistence of erroneous familiarity in an epileptic male:
Challenging perceptual theories of déjà vu activation**

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Abstract

We report the case of a 39 year-old, temporal lobe epileptic male, MH. Prior to complex partial seizure, experienced up to three times a day, MH often experiences an aura experienced as a persistent sensation of déjà vu. Data-driven theories of déjà vu formation suggest that partial familiarity for the perceived stimulus is responsible for the sensation. Consequently, diverting attention away from this stimulus should cause the sensation to dissipate. MH, whose sensations of déjà vu persist long enough for him to shift his perceptual focus a number of times during the experience, spontaneously reports that these shifts make no difference to the sensation experienced. This novel observation challenges data-driven theories of déjà vu formation which have been used to explain the occurrence of déjà vu in those with temporal lobe epilepsy and the general population. Clearly, in epilepsy, erratic neuronal firing is the likely contributor, and in this paper we postulate that such brain firing causes higher-order erroneous ‘cognitive feelings’. We tentatively extend this account to the general population. Rather than being a reaction to familiar elements in perceptual stimuli, déjà vu is likely to be the result of a cognitive feeling borne of the erroneous activation of neural familiarity circuits such as the parahippocampal gyrus, persisting as long as this activation persists.

Keywords

Encephalitis, temporal lobe epilepsy, seizure, aura

Acknowledgements

This research was supported by an ESRC studentship to the first author. The authors wish to thank MH and his wife for their time and enthusiasm, without which this case-report would not have been possible. We are also grateful for the insight and contribution to the field offered by Wilder Penfield, as suggested by an anonymous reviewer.

The persistence of erroneous familiarity in an epileptic male:**Challenging perceptual theories of déjà vu activation**

The sensation of déjà vu has been defined as “[a] clash between two simultaneous and opposing mental evaluations: an objective assessment of unfamiliarity juxtaposed with a subjective evaluation of familiarity” (Brown, 2004, p. 2). The dissociative experience has been reported to occur more in individuals with certain neurological conditions, as an aura in temporal lobe epileptics (Cole & Zangwill, 1963) and as part of the pathology of a migraine (Sacks, 1970), but is nevertheless experienced by most ‘healthy’ individuals (though estimates range from 30% to 100% of the population having experienced it at least once, Brown, 2004).

Different theories of déjà vu formation abound. The authors believe that these theories can be broadly divided into two classifications: data-driven sensori-perceptual theories suggesting that the sensation of déjà vu arises from familiarity evoked by some element of the perceptual input, and higher-order theories suggesting that déjà vu results from an overarching cognitive feeling that is applied to, and not driven by, perceptual input. Of the data-driven accounts, examples include Gestalt familiarity (Dashiell, 1937), single-element familiarity (Leeds, 1944) and optical pathway delay theory (Osborn, 1884). Linking all of these theories is the supposition that the sensation of familiarity underlying the déjà vu experience is incomplete but not erroneous. Gestalt theories relate this to the configuration of perceptual elements, such as the arrangements of objects in a room, while Sno and Linszen (1990) have taken this further by providing a detailed technological analogy for the way in which aspects of the perceptual experience are degraded in their holographic model. Single element familiarity proposes that one item in the perceptual field drives the feeling of familiarity which extends to a vague familiarity for the entirety of the environment. Abstracted slightly further from the perceptual surroundings to the way in which these perceptions are communicated, dual pathway theories such as optical pathway delay have

intuitive appeal and a high public awareness. Optical pathway delay theory postulates that neural signals from one sensory input arrive slightly after the signals from another, leading to the erroneous sensation of having experienced the neurally-replicated event before. Note that even folk psychology notions of *déjà vu* tend to be bottom-up, based on re-experiencing material from past lives, dreams or repetitious acts.

The alternative to such theories is that the sensation of *déjà vu* is higher-order, or driven by erroneous cognitive feelings usually used to successfully interpret cognitive processing. By our account, normal healthy cognitive feelings operate to raise to consciousness mental acts such as remembering, knowing, problem solving and temporary retrieval failure. Normally, cognitive processing is accompanied by appropriate cognitive feelings. A dissociation between the objective knowledge of memory and the subjective sensation of familiarity, removed from perceptual content altogether, is responsible for *déjà vu* according to higher-order theories, and this unusual occurrence may arise from the erroneous activation of familiarity-circuits in the parahippocampal gyrus (Spatt, 2002). Such higher order accounts are likely to be linked to neuronal accounts of *déjà vu* formation, since a candidate mechanism has to be posited which is both higher order, but essentially unpredictable – i.e. not driven by stimuli in the perceptual domain.

This explanation of dissociative experience is consistent with the increased occurrence of *déjà vu* in temporal lobe epileptics with foci in parahippocampal regions (Gil-Nagel & Risinger, 1997) and findings from more invasive electrode implantation studies in which dreamy states incorporating *déjà vu* were induced in a number of patients (Vignal, Maillard, McGonigal & Chauvel, 2007; Bancaud, Brunet-Bourgin, Chauvel, & Halgren, 1994; Penfield & Perot, 1963). Further support for this theory, in comparison to data-driven theories, has been provided by studies examining individuals for whom perceptual pathways associated with the sensation of memory do not exist (O'Connor & Moulin, 2006) and for whom *déjà vu* is associated with temporal lobe pathology (Moulin et al., 2005).

Crucially, data-driven theories of déjà vu formation fail to account for the difference between déjà vu and failed recognition. Why is it that familiarity with a single element should lead to such a clash of cognitions as experienced in déjà vu? It is rather commonplace both in the real world and in psychology experiments to encounter familiar stimuli in unfamiliar contexts, but these do not appear to lead to déjà vu. Consider the experience of encountering a person who feels familiar but about whom nothing can be recalled, or seeing someone you know in an unfamiliar location. These experiences may lead to complete failure (i.e. you do not recognise the person out of context) or interesting phenomenological states (not being able to ‘place the person – the ‘Butcher-on-the-Bus’ phenomenon, Mandler, 1980) but have not been shown to lead to déjà vu.

To foreshadow this case report, data-driven theories of déjà vu formation lead to a testable hypothesis regarding the formation of déjà vu. If it can be established that the experience of déjà vu is not limited to discrete perceptual experiences, but follows the attention of the experiencer through changing situations, then it will be possible to challenge data-driven theories in favour of higher order theories emphasising the erroneous nature of the familiarity characterising the experience. To our knowledge there are no existing reports of directing participants to consider other aspects of a visual scene during the experience of déjà vu. In short, if déjà vu continues when attention shifts to other aspects of the scene, it follows that it is not limited to the perceptual domain.

In the absence of well-established experimental paradigms for the generation of déjà vu, case-studies have provided valuable insights into the nature of the phenomenon. So far, they have been used to speculate on the dopaminergic (Taiminen & Jääskeläinen, 2001) and serotonergic (Kalra, Chancellor & Zeman, 2007) mechanisms of the experience. They have also provided insights into patterns of recollective experience associated with déjà vu (Moulin et al., 2006) and the likelihood of the optical pathway delay theory (O’Connor & Moulin, 2006). Here we extend déjà vu research to involve the temporal lobe epileptic

population, many of whom experience déjà vu as an aura. We report the case of a 39 year-old man, MH who, as a result of encephalitis, developed temporal lobe epilepsy (TLE) at the age of 33. He reported experiencing déjà vu for the first time in his life in association with complex partial seizures, which he has since experienced regularly. During a number of experiences, MH reported looking away from the subject of the déjà vu, only to find that the sensation persisted for whatever he diverted his attention to. As such, this case description provides a hitherto unreported observation of critical insight into the formation and persistence of the déjà vu experience. Crucially, the experience reported is consistent with the pathology of TLE, and inconsistent with data-driven sensori-perceptual theories of déjà vu formation.

Case Report

A 39 year-old, right-handed, caucasian male software engineer, MH, contacted the researchers to offer help with their research. MH had obtained a Physics degree at Oxford and had no history of mental illness. Having recovered from encephalitis at the age of 33, MH suffered resultant TLE, initially with complex partial and generalised seizures, though the generalised seizures have since been controlled with medication. At the time of interview, he was being prescribed the anticonvulsants carbamazepine, levetiracetam, topiramate and clobazam. MH's score on the Dissociative Experiences Scale (DES, Bernstein & Putnam, 1986) was 24.6¹, higher than the general population mean, though within the normal range. The participant gave his written informed consent for the presentation of the case report.

Prior to contracting encephalitis, MH had never experienced déjà vu. As a result, when he first noticed the sensation prior to a complex partial seizure, he suspected that it was a spiritual event. He initially found the experiences frightening and disturbing though this

¹ The DES has a possible range of scores from 0 to 100 with higher scores indicating a greater level of day-to-day dissociative experience.

evaluation has since changed with the understanding that the sensation is a part of his brain injury. Now MH reports that the experiences, lasting between 5 and 60 seconds and occurring from once a month to three times a day, are neutrally valenced. MH describes a typical déjà vu below:

An event will occur and I will have the sensation of knowing that the event was going to happen at that time, and I will recognise every detail of it as it happens. It is as though it has already happened. It is as though I have lived through that period of time before.

The sensation of déjà vu usually signals the onset of a complex partial seizure, during which MH experiences a temporary change in consciousness. To indicate this possibility of a seizure occurring to those in his company, MH will often try and signal that he is experiencing a déjà vu. However, this is made difficult by the impaired verbal communication that occurs to varying degree during his déjà vu, so the signal is usually delivered non-verbally, as a hand signal.

As MH was initially perturbed by the new experience of déjà vu, he tried different ways of stopping it. His seeming ability to recognise every detail of the currently experienced event led MH to believe that he would be able to end the sensation if he diverted his attention to something other than the subject of the déjà vu:

I... went through a period of looking away from what I was recognising, hoping that this would get rid of the déjà vu. I now know that looking away, or at other things doesn't help, because the déjà vu follows my line of vision and my hearing.

Once it occurs, it does not matter what MH diverts his attention to; the sensation persists in all modalities until it either dissolves back to normal consciousness, or into a seizure. The length of the déjà vu experience, sometimes up to 60 seconds in duration, has allowed MH to divert

his attention to numerous events within the same episode and notice the sensation persisting seemingly of its own accord and independent of the number of perceptual episodes it causes him to recognise. This pattern of experience is still a facet of MH's *déjà vu*, though he now knows that the sensation is a normal part of his experience so does not try to stop it.

Discussion

MH's experiences provide valuable insight into the formation of *déjà vu*. By virtue of the fact that his experiences arise more frequently and are often of longer duration than is reported in the general population (consistent with Brown, 2004), MH was able to inadvertently test data-driven theories of *déjà vu* formation by diverting his attention from the supposed cause of the *déjà vu*. In doing so, and noticing the persistence of the experience, sometimes over a number of perceptual diversions, MH came to the conclusion that the sensation of familiarity he was experiencing was not brought about by perceptual stimuli, but by a persisting sensation of familiarity resulting from his TLE, which applied itself to whatever he was experiencing at the time. This conclusion is inconsistent with data-driven accounts of *déjà vu* formation, and is consistent with a brain-based account which influences higher order cognitive feelings, what Penfield would have called an 'interpretive illusion' (1955).

Interestingly, it has been suggested that data-driven theories explain the increased incidence of *déjà vu* associated with TLE. Gloor (1990) proposed that pre-seizure, erratic firing of temporal lobe neurons could result in erroneous matches with previous perceptual experiences, thus giving rise to the sensation of familiarity. Nevertheless, this does not account for the persistence of *déjà vu* across numerous perceptual changes unless each new perception following a shift in attention is related to a new previous perceptual experience. Even so, it is more parsimonious to suggest that erratic neuronal firing in areas responsible for familiarity (Aggleton & Brown, 1999, Spatt, 2002) may cause a generalised sense of

familiarity which extends to all perceived experiences for the duration of the inappropriate neuronal firing, thus giving rise to the sensation of déjà vu (which manifests itself in the electrode stimulation-induced 'dreamy state' in Penfield & Perot, 1963 and Vignal, Maillard, McGonigal & Chauvel, 2007). We note the correspondence between this suggestion and the fact that Penfield labelled the lateral temporal cortex as the “tissue of comparison”(Ferguson et al. 1969).

Additionally, we argue that if a person merely mis-matches memory and the present experience (Gloor, 1990), a more likely outcome is false recognition, not déjà vu. The very nature of déjà vu posits a higher-order awareness of a mismatch between subjective and objective memory processing, since déjà vu is not merely false recognition. This case suggests that since the sensation follows whatever is in the perceptual domain, the disruption to normal processing occurs at a higher order interpretive level, not at the perceptual level.

The fact that MH only started experiencing déjà vu at 33, following the onset of TLE, suggests that this temporal lobe pathology is likely to be associated with the generation of déjà vu sensations. If déjà vu was simply associated with partial familiarity for perceptual stimuli, as data-driven theories would suggest, then MH would have had plenty of opportunity in the years prior to the onset of TLE to have experienced déjà vu for the first time. Additionally, the absence of déjà vu experience prior to TLE onset, as evidenced by the disconcertion MH felt during his first experiences, illustrates that déjà vu is not simply a curiously-evaluated sensation of familiarity, but a discrete cognitive feeling in its own right, which some people can go through their lives without ever experiencing (as MH may well have done had he not suffered encephalitis and resultant TLE). This has implications for déjà vu incidence statistics, suggesting that, rather than being an artefact of introspective evaluation (as suggested by Neppe, 1983), variance in incidence statistics may be indicative of individual differences in predisposition to experience the sensation.

Clearly, this is a case where definite brain damage and the resulting TLE has considerably altered consciousness to the point of prolonged and (at least at first) debilitating sensations of déjà vu. One must therefore be a little cautious in extending such cases to the healthy brain, although there is a long history of using neuropsychological cases and epileptic experiences to elucidate memory mechanisms in less contentious topics than déjà vu (e.g. Scoville and Milner's, 1957, patient HM was vital in establishing the importance of the hippocampus in encoding long-term memory, whilst Tulving's, 1985, patient NN contributed to the understanding of auto-noetic consciousness through its dysfunction). In support of our view, a recent case of persistent déjà vu not caused by epileptic activity resulted in persistent déjà vu that was so severe and so unrelated to perceptual input that the patient shut themselves in a darkened room:

Everything that had happened on Tuesday happened again. This time I went to my room switched off TV, turned off the phone and asked to be left alone. I had the same feeling of having seen and done all of this before... The funny thing with all of this was that if you asked me what was going to happen I didn't know, I just felt that as things were happening I had done it all before and it felt natural for me to know all of this.

Kalra et al. (2007, p. 312)

Similarly, a recent case of persistent déjà vu in Mr M., who was hospitalised with paranoia, déjà vu and mental slowing after taking salvia (Singh, 2007). Throughout his hospitalisation, Mr M. repeatedly experienced déjà vu. If perceptual accounts of déjà vu based on combinations of familiar and unfamiliar elements were behind his experience of déjà vu, one might expect them to reduce once he had become habituated to his surroundings, which did not occur. Finally, with reference to the healthy brain, the fact that questionnaire research has failed to reach consensus on any one trigger for déjà vu (see Brown, 2004, for a review)

indicates, in our view is caused by the fact that déjà vu is not triggered by external stimuli. Interestingly, if there is agreement in the déjà vu literature it is in triggers that are physiological, such as fatigue, and intoxication (e.g. Leeds, 1944, Linn, 1953 and Ellinwood, 1968). Arguably, these factors influence the brain more than the perceptual environment, and we tentatively suggest that higher order disruptions of cognitive processing are caused by minor disruptions to temporal lobe neuronal firing in healthy groups.

It is the authors' belief that the distinctive nature of the déjà vu sensation experienced by MH and by the broader, non-clinical population, arises not from the sensation of familiarity alone, but from the juxtaposition of the subjective sensation of familiarity with the objective knowledge that the familiarity is erroneous. The cognitive feelings framework (Moulin, Conway, Souchay, & O'Connor, in preparation) emphasises the importance of such dissociations in shaping anomalous conscious experience. We suggest that it is in individuals such as MH that dysfunctional temporal circuits provide more of an opportunity for dissociative sensations such as déjà vu to be researched. Consistent with previous findings (O'Connor & Moulin, 2006), déjà vu appears not be a response to perceptual stimuli, but a higher-order sensation with its own neurological antecedents, which shapes our conscious experience of all that we encounter for the duration of the neurological anomaly. Dissociative experiences require further empirical investigation. However, the current case provides an important observation challenging data-driven theories for the formation déjà vu in favour of neurological accounts based on a higher order interpretive illusion.

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