

Letter to the Editor

Response to editor to the comment by Bastin and Besson (2016) to our article entitled "Selective familiarity deficits in otherwise cognitively intact aging individuals with genetic risk for Alzheimer's disease"



We would like to thank Christine Bastin and Gabriel Besson for their thoughtful and pertinent comments regarding our recent article entitled "Selective familiarity deficits in otherwise cognitively intact aging individuals with genetic risk for Alzheimer's disease" [1].

The authors correctly note that, for the analysis of our experiment, recollection was estimated from the proportion of correct recognition accompanied with correct source attribution, whereas familiarity was defined as the proportion of correct recognition in absence of accurate source attribution. Bastin and Besson argue that, defined as such, familiarity scores might be underestimated as both processes are known to co-occur. The authors clearly have a point here as this argument has been raised by dual-process theorists postulating that recollection and familiarity are independent processes. However, across dual-process models, the nature of the interplay and relationship between the two processes of recollection and familiarity remains a matter of debate [2]. For example, Gardiner and Parkin have suggested that recollection and familiarity might instead operate in a mutually exclusive manner [3]. In a different dual-process model proposed by Atkinson and Juola, recollection is believed to come into play only when familiarity fails to provide a clear recognition response [4]. Thus, the possibility that familiarity contributes to some extent to the recollection performance seems to be guided by theoretical considerations and conceptualizations of recollection and familiarity.

Proponents of the independence assumption of recollection and familiarity have in the past introduced mathematical formulas to account for the potential co-occurrence of these two processes during the recollective experience. For example, researchers using the "Remember/Know" method sometimes divide the proportion of "Know" responses by the overall possibility of making a "Know" ($K/(1 - R)$). This approach, also referred to as the Independence Remember/Know procedure, aims to compensate for the fact that

instructions of the Remember/Know task require participants to give "Know" responses only when items are not recollected [5]. Also under the assumption of independence between recollection and familiarity, Jacoby developed the process-dissociation procedure (PDP) to quantify the relative contribution of the two processes involved in recognition [6]. More precisely, the PDP entails the presentation of two separate lists of stimuli that is followed by two distinct recognition conditions, known as the inclusion and exclusion conditions. In the inclusion condition, subjects are asked to endorse any item that was presented before, regardless of its source. In the exclusion condition, subjects are asked to endorse only items from a specific encoding list and to reject any other items. Recollection and familiarity are assumed to operate in concert in the inclusion condition and to act in opposition in the exclusion condition. Therefore, recognition responses in the inclusion condition are assumed to be supported by recollection as well as by the probability that an item is recognized on the basis of familiarity but not recollected [$I = R + F(1 - R)$]. On the other hand, a misattribution in the exclusion condition is believed to occur when an item is familiar but failed to be recollected [$E = F(1 - R)$]. Resolving these equations allows to obtain an estimation of recollection ($R = I - E$) and familiarity [$F = E/(1 - R)$]. Comparably with the PDP, the task we used in our experiment consisted of the encoding of two separate lists of stimuli, together with a two-step recognition procedure. Therefore, although not identical, the memory performance in our experiment can be analyzed using the PDP, and one may apply the same formulas to address the independence assumption as well as the issue of familiarity underestimation, as raised by the comment by Bastin and Besson. In the current experiment, the inclusion score would represent the performance on the Yes/No recognition task, whereas the exclusion score would represent the probability of a source misattribution. To determine if group differences in familiarity were still present when performances are interpreted under the assumption of independence between processes, we recomputed the group statistics using the recollection and familiarity estimates derived from the aforementioned equations. The results are presented in Table 1. The newly computed familiarity estimates remained significantly different between apolipoprotein E (*APOE*) $\epsilon 4$ -negative and *APOE* $\epsilon 4$ -positive groups $F(1,79) = 3.97$ ($P < .05$).

*Corresponding author. Tel.: +1-514-766-2010; Fax: +1-514-888-4050.
E-mail address: dorothee.schoemaker@mail.mcgill.ca

Table 1
Summary of group performances on the recollection and familiarity task

Behavioral performance	<i>APOE</i> ϵ 4 negative, mean (SD)	<i>APOE</i> ϵ 4 positive, mean (SD)	Between-group comparison
Recollection estimate	0.24 (0.10)	0.26 (0.11)	F = 0.61 (ns)
Familiarity estimate	0.50 (0.14)	0.42 (0.14)	F = 3.97*

Abbreviation: SD, standard deviation.

NOTE. All between-group comparisons have been computed using a one-way analysis of variance. ns means not significant according to a $P = .05$ threshold. Familiarity and recollection estimates are derived from the process-dissociation procedure's formulas [6].

*Significant according to an $\alpha = 0.05$ threshold.

A second argument brought forward by Bastin and Besson was the notion that familiarity scores derived from our experimental procedure might encompass a portion of non-criterial recollection. Noncriterial recollection arises when subjects recollect aspects of the encoding event (e.g., a certain thought that occurred during the presentation of the stimulus) that are not relevant to the recollection criterion imposed by the experimental procedure. This leads to the recognition of certain items to be labeled as familiarity, despite the presence of some recollective features. It has previously been demonstrated that familiarity scores can be influenced by the criterion used for recollection [7]. More precisely, a criterion involving a more difficult discrimination between studied lists is likely to lead to an increase in familiarity estimates. The experimental task used in our study was designed to have a loose criterion for recollection, that is, subjects could rely either on the spatial context (left or right presentation), the encoding context (encoding question), or the perceptual context (red or blue screen) to anchor their recollection judgment. Nonetheless, it is difficult, if not impossible, to fully avoid treating recollection in reference to some criterion in the experimental field. However, as subjects from both groups were exposed to the same task, the level of difficulty with regards to the discrimination criterion was constant across groups. Thus, the magnitude of noncriterial recollection tainting the familiarity estimate should be constant across groups and should not influence the group differences in familiarity highlighted in our results. Furthermore, as pointed by Yonelinas and Jacoby, noncriterial recollection appears to be distinct from criterial recollection, and it is possibly relevant to treat this type of recognition as familiarity, rather than recollection [7]. Therefore, we believe that the presence of noncriterial recollection is not

Table 2
Group difference in the recollection ratio of *APOE* ϵ 4 positive and *APOE* ϵ 4 negative

Behavioral performance	<i>APOE</i> ϵ 4 negative, mean (SD)	<i>APOE</i> ϵ 4 positive, mean (SD)	Between-group comparison
Recollection ratio	0.38 (0.13)	0.44 (0.13)	F = 3.50 ($P = .07$)

Abbreviation: SD, standard deviation.

NOTE. All between-group comparisons have been computed using a one-way analysis of variance.

inherently problematic and does not invalidate the findings reported in our study. Yet, it is possible that *APOE* ϵ 4-positive and *APOE* ϵ 4-negative groups differ in their levels of noncriterial recollection. Unfortunately, the present study does not allow examining this question. Future studies would be needed to better characterize fluctuations in non-criterial recollection across different clinical groups.

Another comment formulated by Bastin and Besson is that lower familiarity scores in the *APOE* ϵ 4-positive group, as compared with the *APOE* ϵ 4-negative group, might actually reflect fewer instances of failed recollection. To investigate this assumption further, we computed a recollection ratio score for each subject, representing the proportion of recollection contributing to the overall recognition performance (recollection ratio = recollection rate/hit rate). With a one-way analysis of variance, we contrasted the recollection ratio of *APOE* ϵ 4-positive and *APOE* ϵ 4-negative groups. The results of this analysis are presented in Table 2. Although there is a trend for a statistical difference in recollection ratios between groups, in the absence of reaching the threshold, this finding cannot be interpreted (F = 3.50, $P = .07$). Therefore, it appears that the observed difference in familiarity cannot be fully explained by a superior use of recollection-based recognition in the *APOE* ϵ 4-positive group. Furthermore, using the Remember/ Know method, an increase in recollection scores together with a decrease in familiarity has previously been described in a patient with anterior temporal lobe lesions and relative sparing of the hippocampus [8]. Thus, an increase in recollection scores would not necessarily go against our initial hypothesis that the *APOE* ϵ 4-positive group should present a reduced familiarity due to the higher prevalence of Alzheimer's disease (AD) pathology affecting the rhinal areas in this population.

In their letter, Bastin and Besson further mention that the use of a task providing a pure measure of recollection and familiarity would be preferable to investigate group differences in recollection and familiarity. We couldn't agree more. Unfortunately, to the best of our knowledge, there is currently no task available that would allow to achieve this. Although we fully acknowledge that our experimental procedure has limitations, we also believe that all methods designed to quantify the contribution of recollection and familiarity comprise some form of limitations or biases. For example, although the popular Remember/Know method provides a less-rigid definition of recollection, it is highly influenced by introspective and cognitive abilities, which are known to vary across subjects. Limitations associated with each technique have been previously described [2]. In our study, we have decided to estimate recollection and familiarity using a recognition task requiring subjects to discriminate between separate encoding conditions. This sort of task has been frequently used in the dual-process literature and is generally well accepted. Finally, a previous study comparing results of different experimental paradigms has demonstrated a general agreement in the results derived from different techniques assessing recollection and familiarity performances, when the independence assumption was taken in consideration [5].

Nonetheless, we certainly agree with the authors that it would be useful to replicate these findings with different experimental procedures to assess the consistency of these results across the various techniques.

In summary, we completely agree with Bastin and Besson that more studies are needed to define whether familiarity is impaired in individuals with preclinical AD. As mentioned in the discussion of our original article, although *APOE* ϵ 4-positive individuals are at considerably greater risk for development of the disease, only a certain proportion of ϵ 4 carriers will in fact develop AD over time. Conversely, *APOE* ϵ 4-negative individuals may also very well develop AD over time. Consequently, longitudinal designs studies as well as studies including established AD biomarkers (cerebrospinal fluid, positron emission tomography imaging, magnetic resonance imaging) will be necessary to determine if impairments in familiarity represent a valid cognitive marker of impending AD.

Dorothee Schoemaker*

Jens C. Pruessner

*Department of Neurology & Neurosurgery
McGill Centre for Studies in Aging, McGill University,
Montreal, Quebec, Canada*

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<http://dx.doi.org/10.1016/j.dadm.2016.11.009>