Dear editor

We thank the reviewer for their overall positive feedback and important comments. We made every effort to address all comments. Specifically, we now report the baseline levels of the reproductive hormones of the control group. Also, we amended much of our statistical analysis and added or amended tables and figures in order to optimally address the suggestions of the reviewers. We hope you will find our corrections and our responses to the reviewers satisfactory.

Please note: Changes made appear in **BOLD** in the revised manuscript. Below are our responses to each comment made by the reviewers. To each comment we added our response in **BOLD***.*

Again, we thank the reviewers for their efforts and useful suggestions. We believe the manuscript greatly improved thanks to them.

Reviewer #1:   
-HIGHLIGHTS    
The first highlights says nothing, specify  
The second highlights is included in the third.  
Indicate that the effects of stress on immediate memory appear to be modulated by baseline levels of sex hormones

**Response: We changed the first highlight. It now sates: "Stress disrupts recall after interference on a declarative memory task."**

**The second highlight has been omitted and, as suggested by the reviewer, the last highlight now states: "Effects of stress on memory appear to be modulated by baseline levels of sex hormones".**   
-INTRODUCTION  
The literature review is exhaustive and the manuscript is well written .The need for the study is well argued although the hypotheses need to be operationalized.  
**Response: The operationalized hypothesis is presented at the end of the revised manuscript. We changed the first highlight. It now sates: "Stress disrupts recall after interference on a declarative memory**

-METHOD  
  The influence of chewing on alpha amylase should be acknowledged in the methods.  You say “Before each saliva sampling, participants were told to chew on a piece of parafilm for several seconds to increase saliva secretion” . According to Rohleder and Nater, 2009, in relation with the saliva secretion , it must be done without stimulation. Please, reference the method used in this regard..Indicate reference

**Response: Indeed, as discussed by Rohleder and Nater (2009), studied indicate chewing may affect the relative amount of alpha amylase in the saliva. Thus, Rohleder and Nater, in their paper, recommended to "keep this factor constant within each study". Indeed, in the current study both the stress group and the non-stress control group chewed on a piece of parafilm prior to saliva sampling (in the current study alpha amylase data of the control group is presented). In the revised manuscript this is now mentioned both in the methods section (subsection 2.3) and in the limitation paragraph in the discussion section.**

-RESULTS:  
 The results section does not appear to report alpha amylase levels in the control group, so we are unable to verify that despite chewing, alpha amylase only increased in the stress group.  
**Response: As the reviewer rightfully1 suggested, in the revised manuscript we report alpha amylase as well as cortisol levels in the control group and reanalyzed stress reactivity markers in each group under three-way ANOVA's including stress as independent variable (together with time and hormonal group).**

When reporting the results, they could dichotomize it between pre and post TSST. Presenting them in a sequential order makes it easier to understand the methodology.

**Response: We agree with the reviewer in principle. However, in the course of implementing the suggested format we found that due to the manifold variables in the present research design, the resulted structure was hard to follow. Thus, we decided to adopt a more parsimonious approach, and provided additional data in the supplements as for the pre-stress performance.**

Indicate in tables and figures if the values presented are absolute or transformed

**Response: In the revised manuscript we indicated in table and figure legends if the values presented are absolute or transformed.**

It is necessary to show a graph comparing the response of the biomarkers in both conditions (stress vs. control) and by groups along the experimental session

\*Figures and Tables:  
Figure 2  
Cortisol and alpha amylase levels in the control group should be depicted either in the figures or in a table, particularly for sAA given the stimulatory effects of mastication on this marker.

**Response: In the revised manuscript we provide new figures demonstrating cortisol (Figure 2) and alpha amylase (Figure 3) concentration in the stress as well as in the control group**

Table 2  
Indicate the standard deviations (SD) and complete the table.  The rows for memory task should include pre-stress and post-stress notations.

**Response: In the revised manuscript we completed the table as suggested by the reviewer. We also provided a separate table including the pre-stress memory performance scores in the supplements.**

Do responders and non-responders show the same patterns/magnitudes of stress effects?  
**Response: ANOVA test with responder/non-responder as the between subject variable and memory performance as the dependent variable revealed no main effect and no interaction. Also the curves of both groups are similar. Thus, responders and non-responders showed the same patterns of stress effects on memory performance.**

\*Section 3.1, Stress response, 6th line in first paragraph, the interaction “time x group” is missing

**Response: we rewrote section 3.1 including three-way ANOVAs as well as the missing interaction report. Furthermore, in order to address the hypotheses directly, the report reported in this section relates only to the interaction analyses without the main effects (moreover, some of the main effects are meaningless eventhough statistically significant due to disordinal significant interactions including these variables).**

It seems strange to me that men have a lower cortisol response to stress than the group of women OC, when it is usually this group of women who have an attenuated cortisol response to stress….Were the authors concerned about this fact?

**Response: Although the descriptive statistics depicting the cortisol response to stress suggest group differences, these differences did not reach significance**. 

DISCUSSION  
In the study by Espin et al., 2013, the sample is not only male.

**Response: We thank the reviewer for noticing this error. This has been corrected in the revised manuscript.**

On page 15, Espin et al., indicate the year

**Response: Again, we thank the reviewer for noticing this error. This has been corrected in the revised manuscript.**  
On page 16, Where are the results that you indicate? (r=-0.63, p=0.043)

On page 18, Where are the analyses that  you indicate (ΔR2= .43, F(1,11) = 9.50, p= .010)  
 Response: this was added to supplementary analyses

**Response: In the revised manuscript these results are part of the supplementary analyses**  
LIMITATIONS:  
  Having only basal levels of sex hormones is an important limitation of the study. The results only allows the authors to test whether baseline reproductive hormones modify the stress response.  Their data provides no information as to whether or not sex hormones change in response to stress, or whether those changes could have a modifying impact. The sentence in the abstract and in all paper  “These findings suggest that the effects of stress on memory performance are modulated by sex hormones” you must indicate "could be modulated for baseline reproductive hormones".

**Response: We agree with the reviewer. As we felt that this issue deserved more emphasis than a simple mentioning in the limitation" subsection, we included just prior to it a paragraph stating that: " The current study focused on the relationship between basal sex hormone levels and stress induced effects on verbal memory performance. However, it is important to emphasize that acute stress may increase the secretion of sex hormones (Bedgood et al., 2014; Herrera et al., 2016; Shors et al., 1999), and, thus, it is possible that stress-induced elevations in the levels of sex hormones at least partially accounted for the observed reduction in memory performance. This intriguing possibility will be the subject of future studies in our laboratory. "**

**We also changed the phrasing in the abstract and the rest of the manuscript as suggested by the reviewer.**

 Reviewer #2: This is a nice, novel investigation of the interactions between stress and sex hormones on verbal memory in young men and women. Literature reporting on effects of stress hormones on memory is quite mixed and this paper is an important step towards determining the potential roles of sex hormones in modulating those effects. Analyses focus on men, a group of women taking OCs, and a group of women in the luteal phase, samples which may each demonstrate variations in the effects of stress and sex hormones on memory. The study is thoughtfully designed well to assess these associations. However, there are some major and minor points that warrant clarity and aspects of the writing that should be improved.

**Response: We thank the reviewer for the kind words and positive feedback and hope that we managed to address the mentioned concerns.**

Major:  
1.    The authors rightfully mention statistical power in the limitations. Statistical power is a major concern of these conclusions. A post-hoc power analysis would be helpful to interpret the analyses and the strength of these findings.

**Response: Following reviewer' 2 suggestion, we conducted a post-hoc power analyses, and addressed them in the Discussion section.**

2.    There are recurrent problems with the quality of the writing and errors throughout the manuscript often make the paper challenging to read. These pertain to sentence structure or convoluted/run-on sentences that make it difficult to clearly understand the intended message. A native English-speaker should carefully review the paper for such errors.  
a.    Example: “A moderated regression analyses were conducted using the interaction terms inserted as predictors in the second step of each analysis to predict memory performance (calculated as the difference between before and after stress exposure in memory).”

**Response: We apologize for that. As suggested by the reviewer, a native English-speaker carefully reviewed the revised manuscript.**

3.    Information about sample characteristics is missing. E.g., age, BMI, race/ethnicity…

**Response: In the methods section of the revised manuscript we provide additional information regarding the characteristics of the sample, such as their average BMI and age (p. )**

4.    Given that only one type of memory was assessed, and to aid future searches for this article, it may be helpful to specify “declarative memory” in the title.

**Response: As suggested by the reviewer, the title of the revised manuscript specifically mentions declarative memory.**

5.    As a moderated regression analysis was used, how was the inherent problem of multicollinearity addressed?

**Response: We mean-centered the predictors to calculate the interaction term. This is now mentioned in the revised manuscript. (p.).**

6.    When reporting results, it is common practice to detail the interaction prior to the main effects. Please restructure of Results to match this format.

**Response: We reorganized the results section in order to meet the suggested format.**

7.    Why did the authors decide to use a repeated measures ANOVA instead of calculating area under the curve increase (AUCi) to summarize the change in cortisol and sAA, respectively, over time?

**Response: given the pattern of increase in sAA levels across the experiment (addressed in the Discussion section) we decided calculating delta measures from baseline to peak levels for sAA as well as for Cortisol accustomed in previous studies (e.g., Cornelisse. S., van Stegeren, A. H., & Joels, M. (2011). Implications of psychosocial stress on memory formation in a typical male versus female student sample. *Psychoneuroendocrinology, 36,* 569-578).**

8.    Please add p-values to Table 1.

**Response: The missing p-values are now included in Table 1**

9.    On page 15, what “variations in the memory testing procedure” could explain the discrepancy? Be specific to inform future studies.

**Response: After rethinking this issue, we believe that the most important methodological difference that could account for the discrepancy is the timing of the study (morning Vs after noon). Thus, we changed the paragraph to state the following:**

**"The source for this discrepancy is unclear but may due to differences in the characteristics of the samples, and the timing of the testing. Specifically, the two aforementioned studies were conducted in the afternoon while the current study was conducted in the morning (8:00–10:00 AM). Indeed, a meta-analysis by Het et al. (2005) demonstrated that administration of cortisol (somewhat equivalent to the cortisol reactivity induced by stress) caused memory impairments in studies conducted in the morning and memory enhancements in studies conducted in the afternoon".**

10. It is suggested that the high levels of testosterone account for the modest cortisol response among men, but the authors provide no additional explanation for a modest cortisol response among women beyond typically elevated morning values.

**Response: We believe that the morning cortisol levels during the morning at least partially account for the modest cortisol reactivity also in women. Moreover, we reanalyzed the data and found that the negative correlation between baseline testosterone levels and cortisol reactivity also existed in the women participants. Since the morning testosterone level of women were still much lower than the morning testosterone levels of men, this may also explain why in our study men did not have higher cortisol levels compared to the LP women. We changed this segment of the manuscript accordingly:**

**"…., it is important to note that most previous studies examining stress reactivity were conducted during the afternoon, when cortisol levels are relatively low. In contrast, during the morning hours diurnal cortisol levels are highest (Ghiciuc et al., 2011). Thus, the fact that the proportion of participants demonstrating increased cortisol secretion in response to the TSST (i.e. "responders") in the current study was lower than that typically reported (e.g. Reschke –Hernández et al., 2017; Stephans et al., 2016) may have partially resulted from a ceiling effect mechanism.**

**Indeed, studies inducing stress in the afternoon demonstrated a significantly larger cortisol increase than studies conducted in the morning (Dickerson and Kemeny, 2004) and in the current study responders had significantly higher basal levels of cortisol (but not of reproductive hormones) compared to non-responders. Moreover, in the morning testosterone levels are at their peak in both men and women (Dabbs and de La Rue; 1991; Diver et al., 2003). Consistent with previous evidence suggesting that testosterone may inhibit cortisol stress reactivity (Stephens et al., 2016), in the current study there was a significant negative correlation between basal testosterone levels and the post-stress cortisol levels (see supplementary Table 3). Thus, it is reasonable to deduce that the high levels of testosterone accounted for the relatively modest cortisol response. Moreover, the difference between men and women in morning testosterone levels may account for the fact that in the current study, opposite to finding of previous studies (Reschke –Hernández et al., 2017), cortisol stress reactivity was lower among men compared to LP women".**

11.  Statistics like those on page 18 should be restricted to the Results section.

**Response: We omitted the statistical analyses from the discussion, and reported them in the Supplementary data.**

12. Is there a more parsimonious way to describe the following, “the stress-induced decline in memory performance was negatively associated with the stress-induced increase in sAA.”? These interactions are challenging for a reader to follow and should be simplified if possible to ease interpretation.

**Response: We agree that this interaction is challenging for a reader to follow. In the revised manuscript we tried to simplify it by rephrasing it:**

**"The TSST induced both increase in sAA and a decline in memory performance, and there was a negative association between these two effects among individuals with lower** **progesterone levels. However, there was no association between these effects in individuals with higher progesterone levels".**

13. Add the number of cortisol responders/non-responders to the text.

**Response: The number of responders/non-responders added in the text (p. )**

14. Conducting this study in the morning could be viewed as both a strength and a limitation when comparing the results with previous investigations of hormonal cross-talk conducted with the TSST in the afternoon. This should be noted in the Limitations section.

**Response: We fully agree with the reviewer. Thus the revised manuscript includes the following statement in the limitation subsection of the discussion: "… comparison of the findings of the current study with those of previous studies on the effects of psychosocial stress on the role of stress hormones and reproductive hormones is complicated as these were mostly conducted in the afternoon. However, this can also be viewed as a strength of the current study: the morning is a central time period of the daily schedule that was thus far understudied in research involving stress reactivity."**

15. “. Other forms of declarative memory may be differently affected by the interaction between sex hormones and stress mechanisms.” Please add details regarding which forms of declarative memory are suggested.

**Response: The term "declarative memory" originally referred to memories that could be verbally stated but the term has also been broadened so that it now includes many other kinds of memory, including spatial memory and some types of long-term visual memory . Accordingly, in the revised manuscript we specify that "…other forms of declarative memory, such as long-term visual memory and spatial memory, may be…."**

16. The young age of the sample (although the average age is not included overall or by women and men) limits the generalizability. This should be mentioned in the Limitations.

**Response: This now mentioned in the limitation subsection of the discussion.**

Minor:  
1.    “This discrepancy may have partially…” requires a citation related to differing glucocorticoid sensitivity

**Response: The original sentence was not accurately phrased. We changed the sentence to state the following: " This discrepancy may be explained by methodological differences, such as in the memory testing procedure used or the time of testing (morning Vs afternoon).**

2.    A citation could be helpful at the end of “which could lead to considerable variability because of the short‐time pulsating dynamics of sex hormone secretion.”

**Response: We added the following citation for the pulsating dynamics of sex hormones:**

**Keenan, D.M., Veldhuis, J. D., 2016. Pulsatility of Hypothalamo-Pituitary Hormones: A** **Challenge in Quantification. Physiology (Bethesda). 31(1), 34-50.** **https://doi.org/10.1152/physiol.00027.2015.**

3.    Please consistently capitalize Tables and Figures throughout the paper. See pgs 6, 9, 10, 11, and 13.

**Response: We capitalized Tables and Figures throughout the revised manuscript.**

4.    There are numerous typos and missing words. Some of these oversights are quite major such as the first sentence of the Conclusions, “psychosocial stress enhances disrupts aspects of declarative memory.” It is challenging to determine what the authors mean here. Others: “a time a time period”, “However, LP women had significantly higher did not differ significantly between the groups”, “dealing with inference is”, “the porportion”, “The TSTT”

**Response: We apologies for these typos. A native English-speaker carefully reviewed the** **revised manuscript prior to submission.**