Response to Reviewers (mSystems00144-16R2)

We thank the Reviewer #2 for the comments, as they have been really helpful to complete our work and make it clear.

**Reviewer #2**

*Comments for the Author:*

*The authors have made significant improvements to the manuscript and addressed many of the reviewer comments. I think the new analyses included from the David paper have added a lot (e.g. following how parameters change as host health/behavior changes). However, there are still several issues that need to be addressed.  
  
General Comments:  
  
1) While it is clear that the language is much improved, the manuscript is still riddled with grammatical and compositional issues. I will enumerate some of these errors from the first paragraph of the Introduction to give an example, but will refrain from language-editing the entire paper, as this would take up too much of my time. I suggest the authors have another native-speaker, who is also scientifically literate, provide edits.  
  
lines 47-50: This sentence feels off, with too many 'such as' and commas. The first clause of the sentence is strange, and could be put more simply. For example: 'The human microbiome is intimately linked to our physiology...'. Also, replace 'key-route metabolites' with 'key metabolites'.  
  
line 52: replace 'affections' with 'afflictions' or 'conditions'  
  
line 53: replace 'other multiple' with 'many other'  
  
lines 52-55: Awkward sentence. Replace 'Current studies reveal' with 'Recent studies have revealed'. Replace 'microbiota also influences' with 'microbes also influence'. Replace 'and is related' with 'and are related'. Replace brain-gut-microbiome axis' with 'gut-brain axis'  
  
lines 55-58: replace 'mystifying and elusive' with 'subtle' and delete 'which is hard to diagnose'. Replace 'closely related to' with 'associated with'*

* All the changes mentioned for the first paragraph have been applied, and the manuscript has been sent to another English editor.

*2) Your modeling approach and analyses are clearer now that you have filled in with more text. I am now convinced of the utility of you Taylor's Law fitting in defining community stability. However, there are still significant gaps. For example, you talk about phase transitions in F/V space. There are very formal definitions of phase transitions (e.g. first and second order) in physics. I see that you define the transition in terms of the Fokker-Plank equation, and that the two phase regions are defined by an 'order' parameter. Is the crossing of this phase-boundary non-continuous? What is the state variable that pushes the community to different locations in this phase-plane? Disturbance intensity/duration? You should bring more discussion of the phase space and how you define phase transition into the main body of the results and discussion. Why didn't you include all your time series in the V vs. F phase plot (Fig. 3). If you include all your data, how often do unhealthy people fall within the healthy range of phase space, and how often does the opposite occur? Would you consider Fig. 2 to be fairly equivalent to Fig. 3?*

* Carlos should answer these issues.

*Specific Comments:  
  
line 90: You seem to be saying that microbial dynamics 'affect' host health status. But I saw no attempt to infer causality in your results section. Be careful about implying causality.*

* Your point is right, and it has been changed to avoid causality.

*lines 106-105: Are you saying that Taylor's parameters are correlated with an independent measure of community stability? Or that you are assuming they are proxies for stability? Also, you should mention that V is the y-intercept in Fig. 1, while beta is the slope of the line (both in the manuscript and in the figure caption).*

* We are implying that Taylor’s parameters are proxies for stability. As this seems to be unclear, we have added further explanations in the section XXX

*lines 113-115: Please provide a reference for this Medicare factoid. Also, delete 'stable such as, for example,' and replace with 'stable, similar to'.*

* Reference added to the text and grammar fixed.

*lines 125-126: Label axes with 'beta' and 'V' parameter names, for consistency.*

* Axis labels changed to V and beta. TO DO!

*Figure 2: There seems to be a flaw in your zone of health. You've presented a 2-D Gaussian distribution around your 0-centered normalized results. However, I don't think this is correct. Conceptually, there shouldn't be any lower threshold on beta and V where you cross from healthy to unhealthy (just getting more and more stable as those numbers decrease). Very low beta and V are likely to be healthy. I would only expect samples in the upper-right quadrant to be 'unhealthy'. Thus, the boundary of the unhealthy zone should probably look like a rectangle with its upper right corner rounded.*

* Explain better, change things?

*line 156: Is there precedent in the literature for defining an organism's fitness as its recovery half-life? If so, please provide reference.*

* Look for this.

*line 158: Are the V and beta parameters from the Langevin equation equivalent to the same parameter from Taylor's law? If so, please state. If not, please give this parameter a different name to avoid confusion. Also, how correlated are the F, V, and beta parameters for each of your model fits?*

* Yes, the V and beta parameters of both parts are equivalent. In order make it clear, we have added further explanations in the XXX section. Completar la segunda parte

*Figs. 4-5: Describe the panels showing DV and RV (and define these parameters) in the figure caption. How are you defining your medium-ranked stability islands? Quantitatively? Do you see a steady/linear decay in RSI as you move down in average rank? Is there a plateau at medium average ranks? Is there a non-monotonic trend? This is hard to see with just numbers. Maybe try plotting RSI as the width of your average rank colorbar, or show a line-plot with RSI on the y-axis and average rank on the x-axis.*

* TO DO!

*line 214: You say you used the 'largest sampling' time series for Fig. 6. Is this still true after including the paper from David et al.? I think the female time series from the Caporaso paper is shorter than both the time series form the David paper. Also, you mention that you calculated beta and V, but only plot V. Why not show beta as well?*

* This point is right. We have changed that part in the Figure 6.

About the other concern, we did not include the beta plots for several reasons. In one hand, beta time variation is less informative than V plots as the error of beta is often higher in proportion to V. On the other hand, for this particular work we wanted to plot how the variability (V) evolved over time as it is the most useful of the Taylor parameters. We plan to study also beta variations in the future.

As this seemed unclear, we added further explanations in the Results section.