Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Villification of the gut TUOMAS TALLINEN, University of Jyväskylä, AMY E. SHYER, CLIFFORD J. TABIN, L. MAHADEVAN, Harvard University — The villi of the human and chick gut are formed in similar stepwise progressions, wherein the mesenchyme and attached epithelium first fold into longitudinal ridges, then a zigzag pattern, and lastly individual villi. We combine biological manipulations and quantitative modeling to show that these steps of villification depend on the sequential differentiation of the distinct smooth muscle layers of the gut, which restrict the expansion of the growing endoderm and mesenchyme, generating compressive stresses that lead to their buckling and folding. Our computational model incorporates measured elastic properties and growth rates in the developing gut, recapitulating the morphological patterns seen during villification in a variety of species. Our study provides a mechanical basis for the genesis of these epithelial protrusions that are essential for providing sufficient surface area for nutrient absorption.

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Date submitted: 14 Nov 2013 Electronic form version 1.4