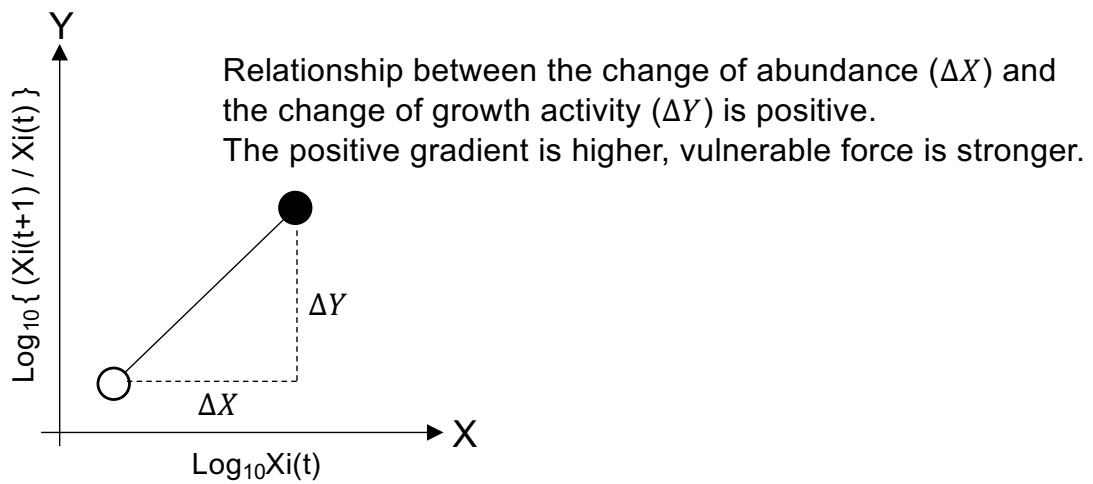


Stable States of a Microbial Community Are Formed by Dynamic Metabolic Networks with Members Functioning to Achieve Both Robustness and Plasticity

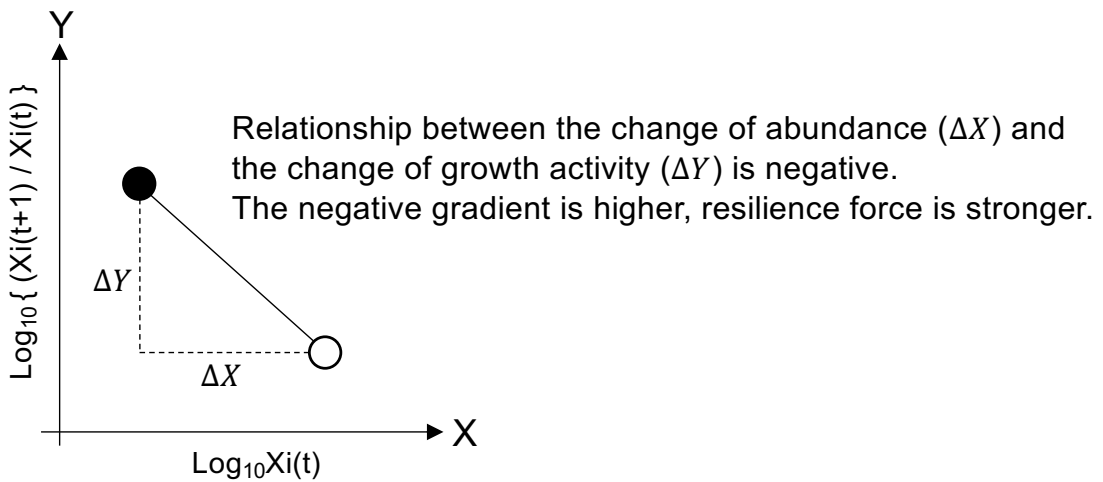
メタデータ	言語: en 出版者: Japanese Society for Extremophiles 公開日: 2024-05-14 キーワード (Ja): キーワード (En): 作成者: Honjo Masahiro, Suzuki, Kenshi, Katai Junya, Tashiro, Yosuke, Aoyagi Tomo, Hori Tomoyuki, Okada Takashi, Saito Yasuhisa, Futamata, Hiroyuki メールアドレス: 所属:
URL	http://hdl.handle.net/10297/0002000607

Supplementary Figure S1

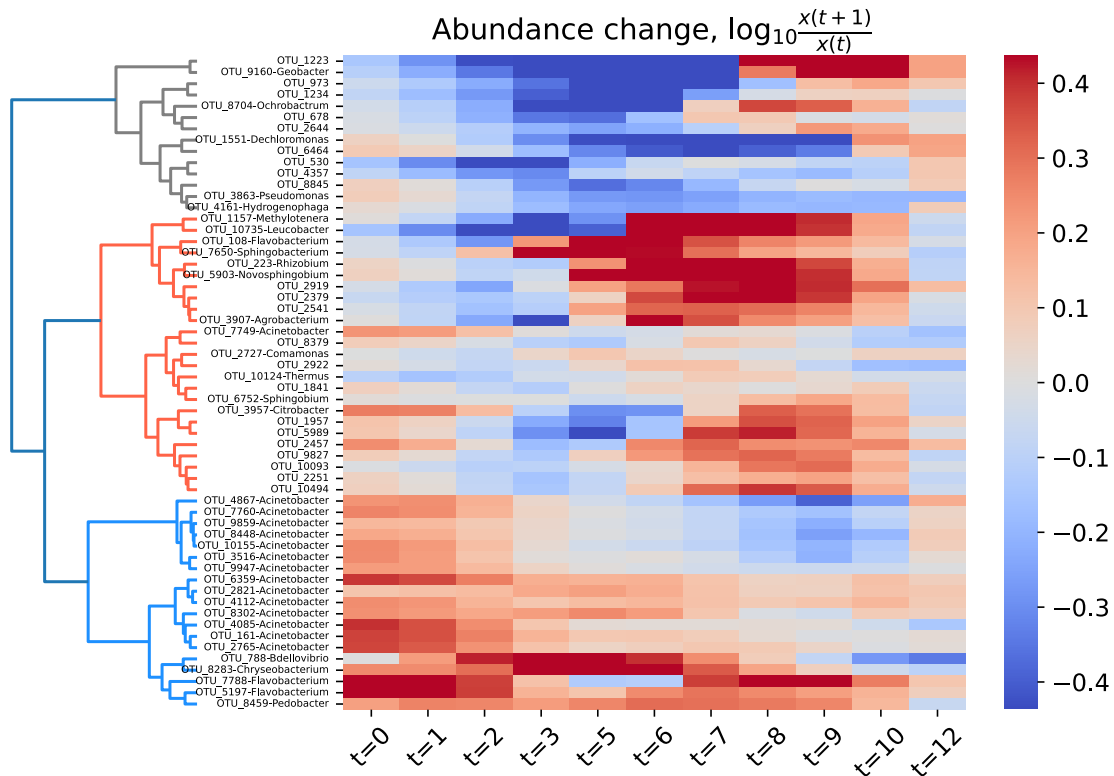
(a) Vulnerable force



(b) Resilience force

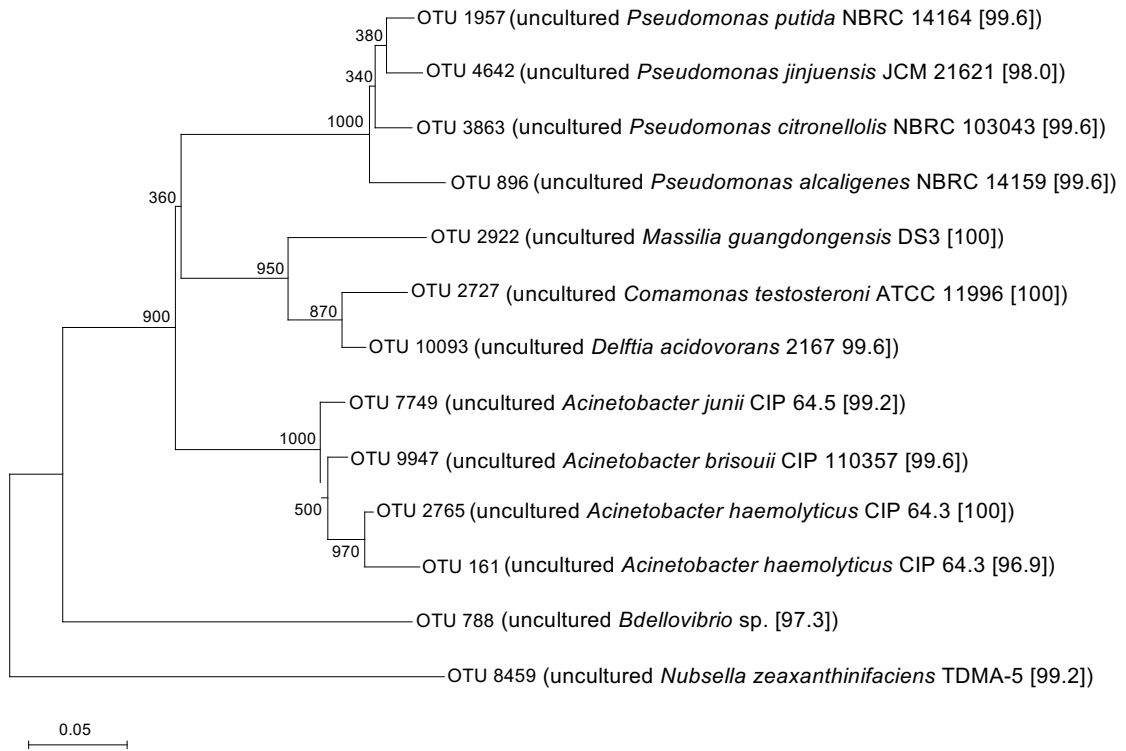


Supplementary figure S2



A clustering analysis based on this experimental data indicated that the growth activities of common OTUs detected in one of the three replications at least from the soil sample to the 15th transferred cultures were grouped into 3 clusters: 1) Pronounced growth activity in the early stages, 2) Pronounced growth activity in the later stages, 3) Negative growth activity throughout the experiment, which are shown in blue, red, and gray clusters, respectively. “t = 0” indicates soil sample.

Supplementary figure S3



Supplemental Figure S3. Unrooted neighbor-joining tree based on the nucleotide sequences of partial 16S rRNA genes corresponding to the core OTUs.

Most related microorganisms were described in parentheses. The number shown in a bracket indicates percentage of homology. Numbers at the branch nodes are bootstrap values (per 1000 trials). There is no gap in any sequences. The bar represents 0.05 substitution per site.

Supplementary Figure S4

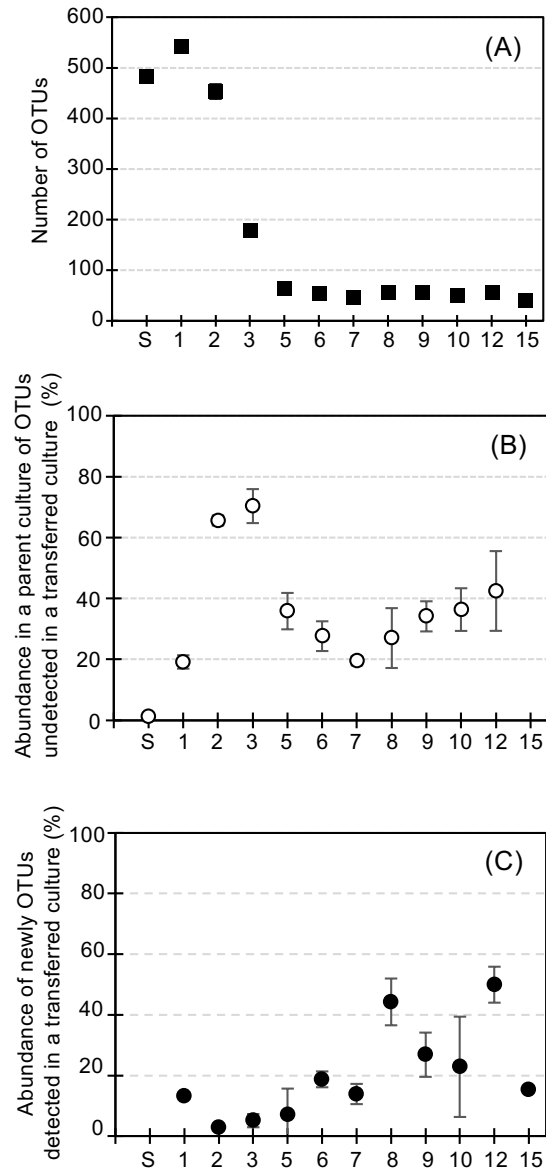
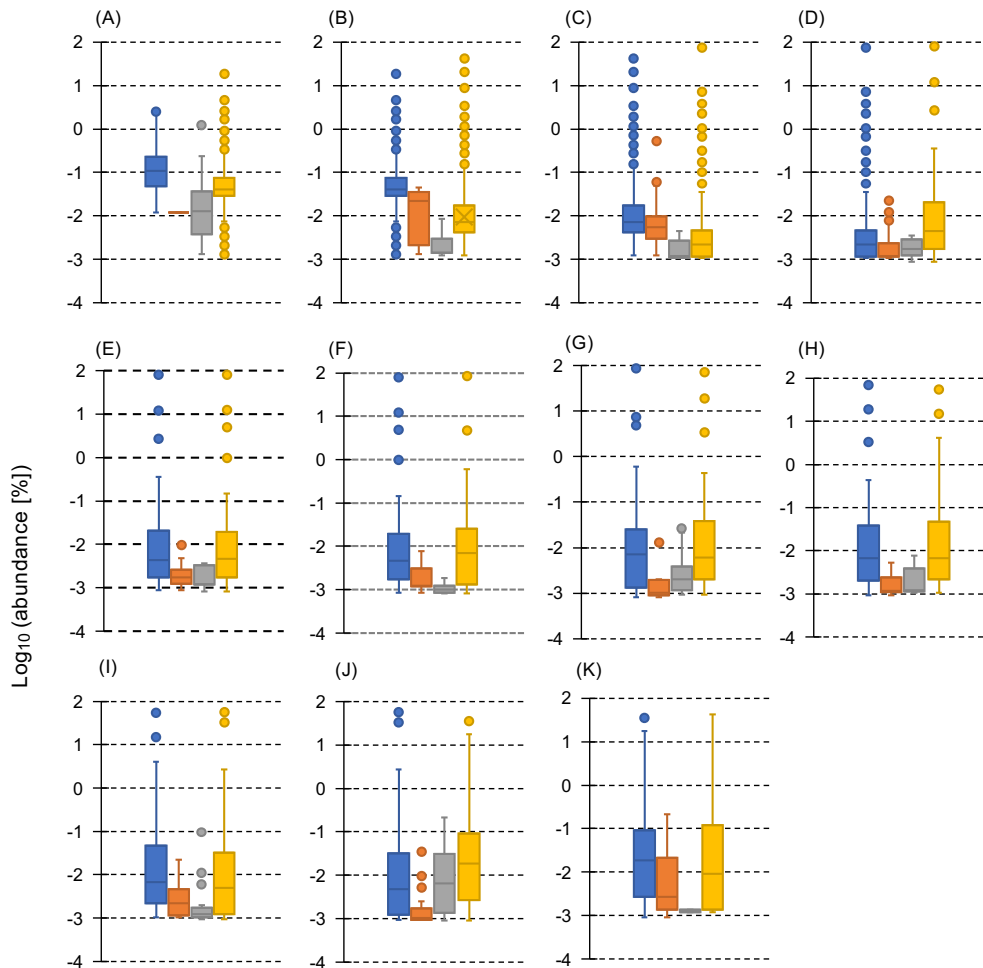


Figure S4. Changes of OTUs abundance.

(A) Number of OTUs in soil and transferred cultures, (B) Abundance in a parent culture of OTUs undetected in the transferred cultures, (C) Abundance of OTUs newly detected in a transferred culture. All symbols mean average of abundance, and error bar means standard deviation (n = 3).

Supplementary Figure S5



Supplemental Figure S5. Succession of bacterial populations as OTUs level.

Abundance of total OTUs in a parent culture, disappeared OTUs, newly appeared OTUs, and total OTUs detected in a transferred culture.

(A) From soil to the 1st transferred cultures, (B) From the 1st to the 2nd transferred cultures, (C) From the 2nd to the 3rd transferred cultures, (D) From the 3rd to the 5th transferred cultures, (E) From the 5th to the 6th transferred cultures, (F) From the 6th to the 7th transferred cultures, (G) From the 7th to the 8th transferred cultures, (H) From the 8th to the 9th transferred cultures, (I) From the 9th to the 10th transferred cultures, (J) From the 10th to the 12th transferred cultures, (K) From the 12th to the 15th transferred cultures. Blue bars mean abundance of total OTUs in parent cultures, red bars mean abundance in parent cultures of OTUs undetected in the transferred cultures, gray bars mean abundance of OTUs newly detected in the transferred cultures, yellow bars mean abundance of OTUs in the transferred cultures.

Supplementary Table S1. Population dynamics on OTUs level from the 5th to the 10th transferred cultures

#OTU ID	5th	6th	7th	8th	9th	10th	#OTU ID	5th	6th	7th	8th	9th	10th
OTU76	-	-	-	-	-	-	OTU4401	-	-	-	-	-	-
OTU108	-	-	-	-	-	-	OTU4465	-	-	-	-	-	-
OTU161	-	-	-	-	-	-	OTU4586	-	-	-	-	-	-
OTU201	-	-	-	-	-	-	OTU4642	-	-	-	-	-	-
OTU223	-	-	-	-	-	-	OTU4782	-	-	-	-	-	-
OTU381	-	-	-	-	-	-	OTU4849	-	-	-	-	-	-
OTU425	-	-	-	-	-	-	OTU4867	-	-	-	-	-	-
OTU492	-	-	-	-	-	-	OTU5110	-	-	-	-	-	-
OTU530	-	-	-	-	-	-	OTU5169	-	-	-	-	-	-
OTU678	-	-	-	-	-	-	OTU5197	-	-	-	-	-	-
OTU788	-	-	-	-	-	-	OTU5237	-	-	-	-	-	-
OTU896	-	-	-	-	-	-	OTU5399	-	-	-	-	-	-
OTU973	-	-	-	-	-	-	OTU5470	-	-	-	-	-	-
OTU1084	-	-	-	-	-	-	OTU5875	-	-	-	-	-	-
OTU1234	-	-	-	-	-	-	OTU5876	-	-	-	-	-	-
OTU1242	-	-	-	-	-	-	OTU5903	-	-	-	-	-	-
OTU1313	-	-	-	-	-	-	OTU5967	-	-	-	-	-	-
OTU1330	-	-	-	-	-	-	OTU5976	-	-	-	-	-	-
OTU1338	-	-	-	-	-	-	OTU5989	-	-	-	-	-	-
OTU1450	-	-	-	-	-	-	OTU6038	-	-	-	-	-	-
OTU1551	-	-	-	-	-	-	OTU6057	-	-	-	-	-	-
OTU1578	-	-	-	-	-	-	OTU6074	-	-	-	-	-	-
OTU1599	-	-	-	-	-	-	OTU6112	-	-	-	-	-	-
OTU1671	-	-	-	-	-	-	OTU6320	-	-	-	-	-	-
OTU1826	-	-	-	-	-	-	OTU6359	-	-	-	-	-	-
OTU1841	-	-	-	-	-	-	OTU6396	-	-	-	-	-	-
OTU1940	-	-	-	-	-	-	OTU6464	-	-	-	-	-	-
OTU1957	-	-	-	-	-	-	OTU6737	-	-	-	-	-	-
OTU2004	-	-	-	-	-	-	OTU6752	-	-	-	-	-	-
OTU2043	-	-	-	-	-	-	OTU6825	-	-	-	-	-	-
OTU2144	-	-	-	-	-	-	OTU7164	-	-	-	-	-	-
OTU2251	-	-	-	-	-	-	OTU7650	-	-	-	-	-	-
OTU2298	-	-	-	-	-	-	OTU7749	-	-	-	-	-	-
OTU2379	-	-	-	-	-	-	OTU7760	-	-	-	-	-	-
OTU2404	-	-	-	-	-	-	OTU7788	-	-	-	-	-	-
OTU2457	-	-	-	-	-	-	OTU7794	-	-	-	-	-	-
OTU2503	-	-	-	-	-	-	OTU7806	-	-	-	-	-	-
OTU2541	-	-	-	-	-	-	OTU7981	-	-	-	-	-	-
OTU2572	-	-	-	-	-	-	OTU8098	-	-	-	-	-	-
OTU2609	-	-	-	-	-	-	OTU8283	-	-	-	-	-	-
OTU2644	-	-	-	-	-	-	OTU8302	-	-	-	-	-	-
OTU2689	-	-	-	-	-	-	OTU8379	-	-	-	-	-	-
OTU2700	-	-	-	-	-	-	OTU8448	-	-	-	-	-	-
OTU2701	-	-	-	-	-	-	OTU8459	-	-	-	-	-	-
OTU2705	-	-	-	-	-	-	OTU8528	-	-	-	-	-	-
OTU2712	-	-	-	-	-	-	OTU8531	-	-	-	-	-	-
OTU2714	-	-	-	-	-	-	OTU8551	-	-	-	-	-	-
OTU2727	-	-	-	-	-	-	OTU8704	-	-	-	-	-	-
OTU2765	-	-	-	-	-	-	OTU8726	-	-	-	-	-	-
OTU2821	-	-	-	-	-	-	OTU8845	-	-	-	-	-	-
OTU2919	-	-	-	-	-	-	OTU9026	-	-	-	-	-	-
OTU2922	-	-	-	-	-	-	OTU9107	-	-	-	-	-	-
OTU3035	-	-	-	-	-	-	OTU9276	-	-	-	-	-	-
OTU3063	-	-	-	-	-	-	OTU9334	-	-	-	-	-	-
OTU3293	-	-	-	-	-	-	OTU9481	-	-	-	-	-	-
OTU3390	-	-	-	-	-	-	OTU9609	-	-	-	-	-	-
OTU3496	-	-	-	-	-	-	OTU9827	-	-	-	-	-	-
OTU3516	-	-	-	-	-	-	OTU9848	-	-	-	-	-	-
OTU3595	-	-	-	-	-	-	OTU9859	-	-	-	-	-	-
OTU3863	-	-	-	-	-	-	OTU9947	-	-	-	-	-	-
OTU3907	-	-	-	-	-	-	OTU10057	-	-	-	-	-	-
OTU3957	-	-	-	-	-	-	OTU10093	-	-	-	-	-	-
OTU3979	-	-	-	-	-	-	OTU10124	-	-	-	-	-	-
OTU4042	-	-	-	-	-	-	OTU10155	-	-	-	-	-	-
OTU4085	-	-	-	-	-	-	OTU10263	-	-	-	-	-	-
OTU4112	-	-	-	-	-	-	OTU10481	-	-	-	-	-	-
OTU4161	-	-	-	-	-	-	OTU10494	-	-	-	-	-	-
OTU4197	-	-	-	-	-	-	OTU10594	-	-	-	-	-	-
OTU4357	-	-	-	-	-	-	OTU10735	-	-	-	-	-	-
OTU4391	-	-	-	-	-	-	OTU10821	-	-	-	-	-	-
OTU4396	-	-	-	-	-	-							

The abundance indicates average of abundance in triplicated samples. Black; abundance $\geq 1\%$, gray; $0.1\% \leq$ abundance $< 1\%$, blue; $0.01\% \leq$ abundance $< 0.1\%$, green; $0.001\% \leq$ abundance $< 0.01\%$ and white; abundance $< 0.001\%$. These values are average of abundance in triplicated cultures including undetected samples. “-”; Not detected in all triplicated samples. The OTU colored with yellow means the core OTU that was detected in all triplicated samples from the 5th to the 10th transferred cultures.

Supplementary material 1

Parameters used for the simulation

In the simulation of the consumer-resource model with metabolic leakage, we assumed that there two types of resources (phenol and its metabolites) and 200 species. It was assumed that these 200 species are categorized into three distinct groups, with species in the same group having similar metabolic preference, c_{ia} . The numbers of species in the three groups are 50, 50, and 100, respectively.

We set D_{ba} to be $D_{ba} = \begin{pmatrix} 0.5 & 0.0 \\ 0.5 & 1.0 \end{pmatrix}$, where $D_{10} = 0$ because we assumed that phenol is not converted to the secondary product within bacteria. For c_{ia} , we first constructed a group-level preference matrix,

$$c_{Ia} = \begin{pmatrix} 1.8 & 0.2 \\ 0.3 & 1.5 \\ 0.8 & 0.8 \end{pmatrix},$$

where the three rows correspond to the three groups of species. Then, for a species i belonging to the I -th group, c_{ia} is determined by multiplying to c_{Ia} a random normal variable with mean 1 and variance 0.1. For the other parameters, we set $l_a = 1$, $w_a = 1$, $m_i = 0$, and g_i for each i is drawn from a normal distribution with mean 1 and variance 0.17.