Science Advances
AAAS

Supplementary Materials for

Technical reasoning bolsters cumulative technological culture through convergent transformations

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Published 2 March 2022, *Sci. Adv.* **8**, eabl7446 (2022)
DOI: 10.1126/sciadv.abl7446

This PDF file includes:

Figs. S1 to S5
Table S1

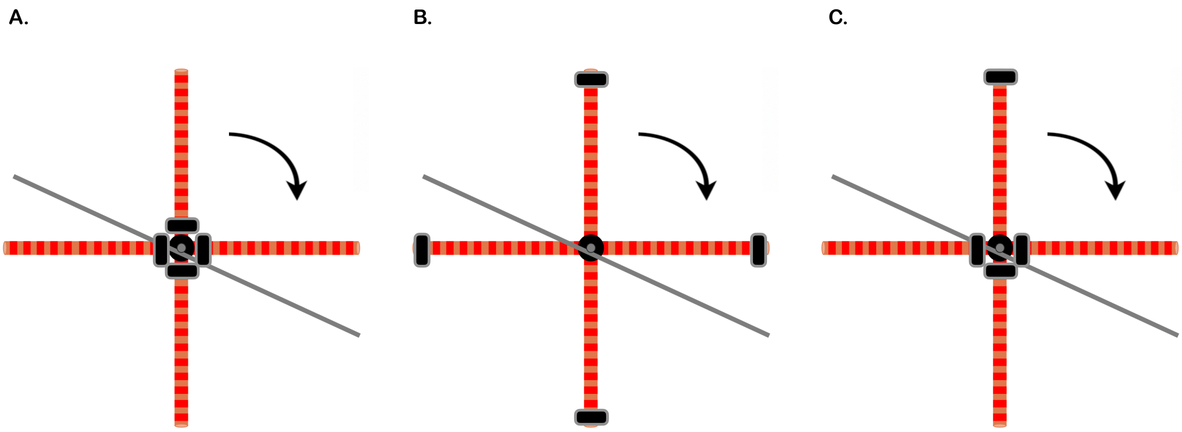

Fig. S1. Moment of inertia and position of the center of mass. Moment of inertia: A wheel with its four weights close to its center (**A**) is faster than a wheel with its four weights farther from the center (**B**). Position of the center of mass: The initial acceleration is better when the wheel is unbalanced with the center of the mass located ahead and above the axis of the wheel. Thus, the wheel **C** will have a better initial acceleration than the wheel **A**. Three illustrations are provided at https://osf.io/m3d7q/. The grey line here represents the track.

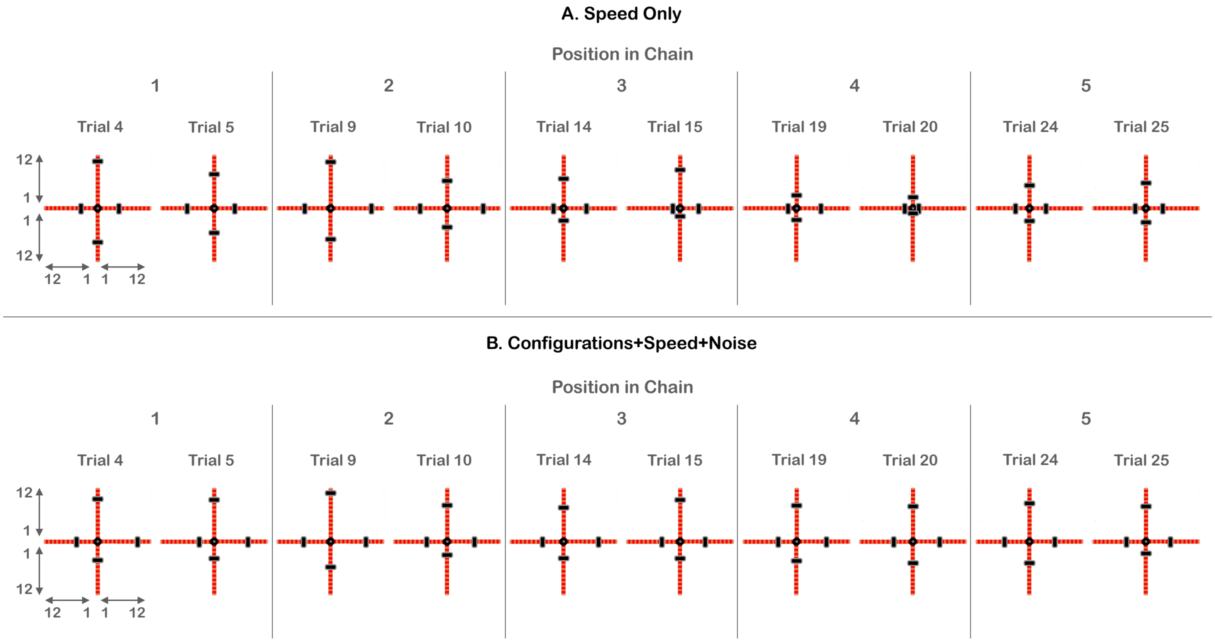

Fig. S2. Evolution of wheel configurations over generations. A. Speed-Only condition. **B.** Configurations+Speed+Noise condition. Only the last two trials of each generation are shown. The position of each weight corresponds to the median position of the weight for each trial.

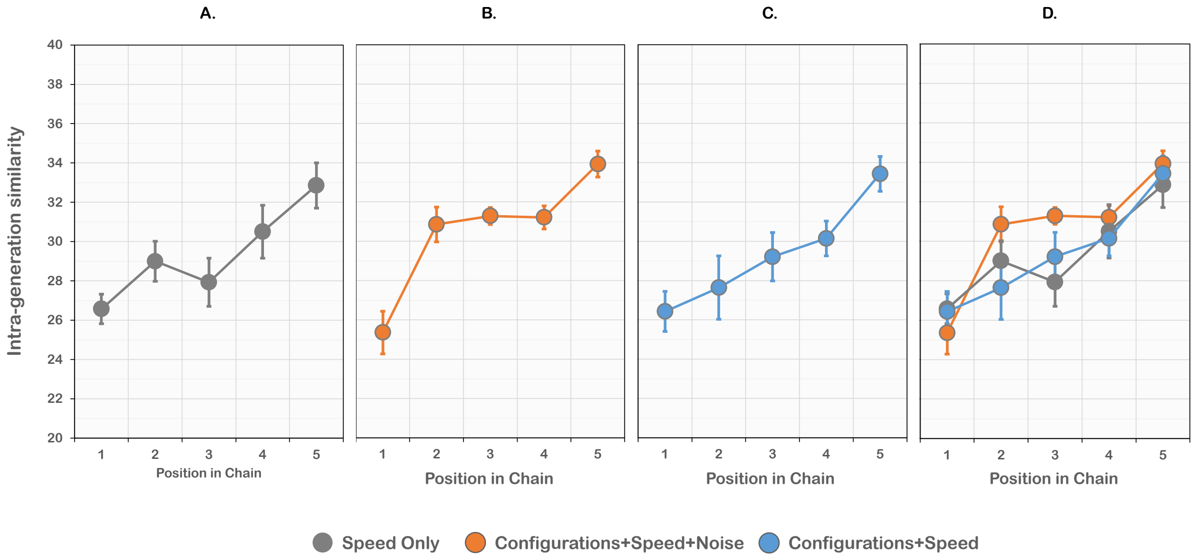

Fig. S3. Increase of the intra-generation similarity score over generations. A. Speed-Only condition (grey) of the present study. **B.** Configurations+Speed+Noise condition (orange) of the present study. **C.** Configurations+Speed condition (blue) of Osiurak et al. (*41*). **D.** The three conditions are shown together. Bars indicate standard errors.

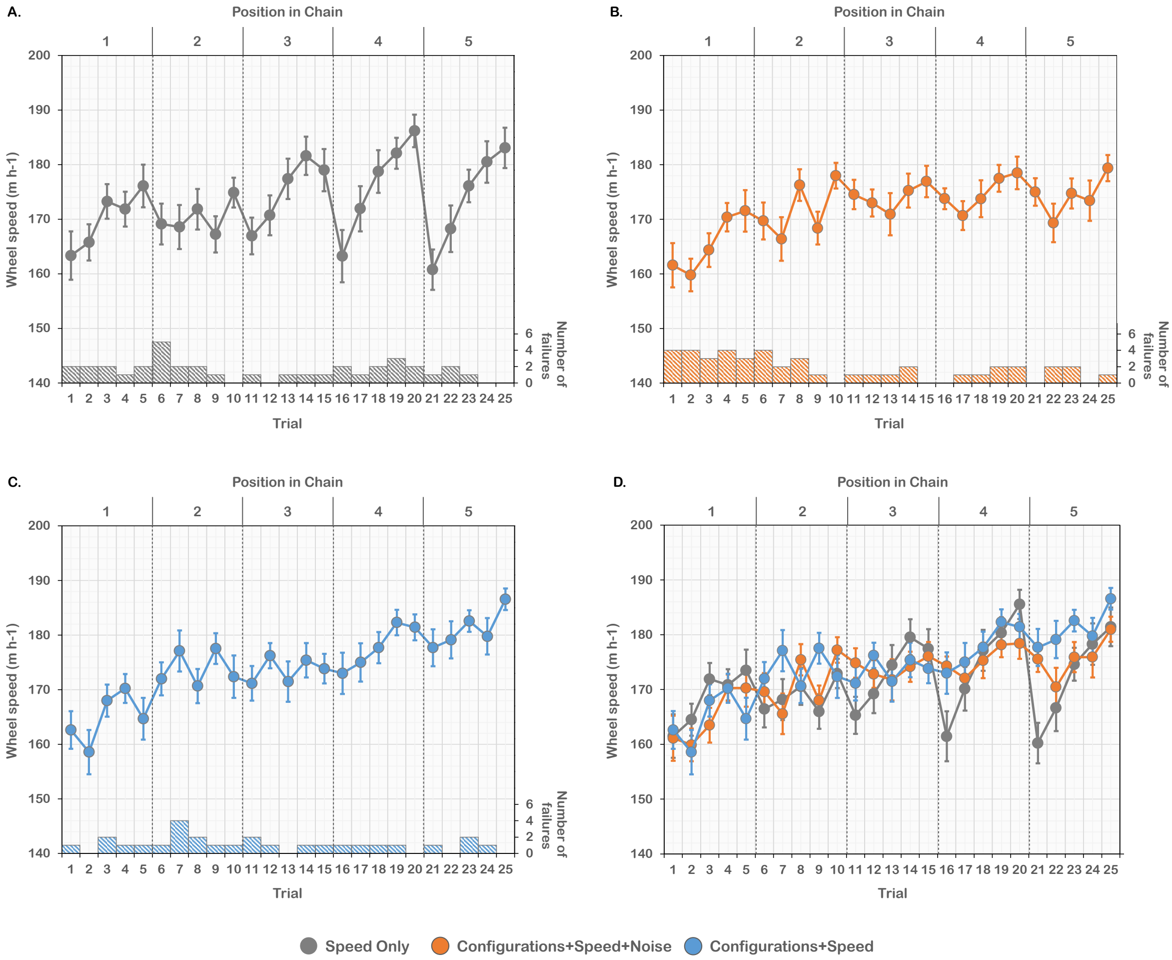

Fig. S4. Evolution of the wheel speed over generations. A-B. Wheel speed over generations for non-failure wheels and number of failures in the Speed-Only condition (grey) and in the Configurations+Speed+Noise condition (orange) of the present study. **C.** Wheel speed over generations for non-failure wheels and number of failures in the Configurations+Speed condition (blue) of Osiurak et al. (*41*). **D.** The three conditions are shown together. Bars indicate standard errors.

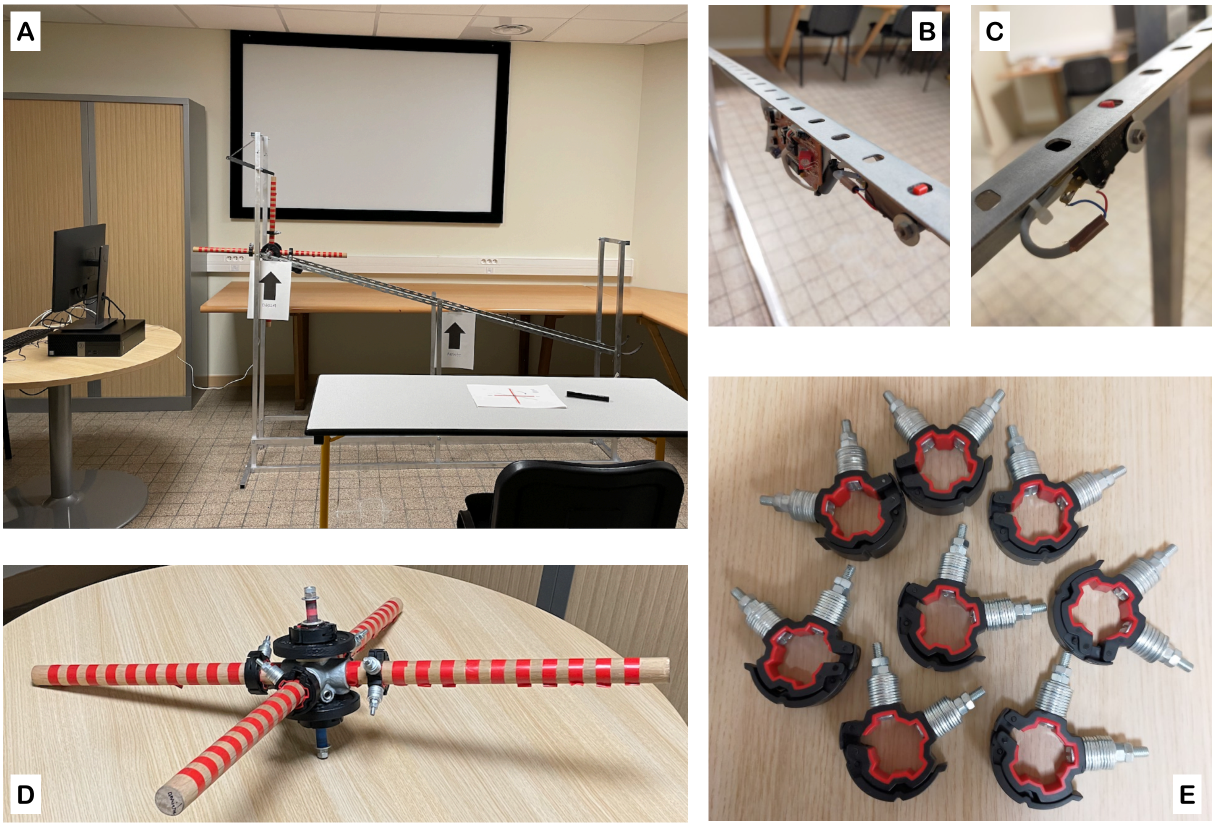

Fig. S5. Experimental apparatus. A. Experimental setup. Rails were made up of 2-meter-long plated steel slotted angles (20 mm wide) and were held at an incline of 14° by an aluminium and steel structure. A mechanical lever was used to maintain the wheel motionless. **B-C.** Two push-button switches (made from computer mice) connected to the computer program used to calculate the speed of the wheel. **D.** The wheel was made up of a tube clamp, which formed a 90° angle between the axis of the wheel and the 4 spokes (with a 90° angle between the spokes). The axis took the form of a 10.5-cm-long bored-through wooden pole and an 8 mm threaded steel rod in its centre. The end of the axis was covered with pieces of rubber tube to prevent the wheel from sliding on the rails. Flat washers were added on either side of the pieces of rubber tube to guide the wheel along the rails. One 500g weight plate was positioned on each side of the clamp. Two barbell clamp collar flips were added to keep the weight plates in position. The spokes of the wheel were four 28mm wooden poles, which were 41cm long from the centre of the wheel. The 12 weights' potential positions were identified by pieces of red tape positioned every 28mm along the spokes. **E.** Barbell clamp collar clips that were weighted with screws, nuts and flat washers were used as weights (about 100g).

Table S1. Number of balanced/unbalanced wheels and wheels that descended/did not descend.

Condition	Total number of wheels	Balanced wheels	Unbalanced wheels	Wheels that descended (> 0 m h^{-1})	Wheels that did not descend (0 m h^{-1})
Speed-Only	350	191 *(.55)*	159 *(.45)*	313 *(.89)*	37 *(.11)*
Configurations+Speed+ Noise (Wheels produced by the participants)	350	75 *(.21)*	275 *(.79)*	306 *(.87)*	44 *(.13)*
Configurations+Speed+ Noise (Wheels modified before transmission)	112	3 *(.03)*	109 *(.97)*	82 *(.73)*	30 *(.27)*

A wheel was considered as balanced when both [$\text{Position}_{\text{Top Weight}}$ – $\text{Position}_{\text{Bottom Weight}}$] and [$\text{Position}_{\text{Front Weight}}$ – $\text{Position}_{\text{Back Weight}}$] equaled 0. Otherwise, the wheel was considered as unbalanced [for a similar procedure, see (*22*)].