

Supplemental Online Materials

for

Sticky tradition impedes selection of creative ideas

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Pilot studies

For our stimuli, we generated a pool of 42 objects. Pictures of these objects were taken from the Pixabay library (Pixabay GmbH, Berlin). We focused on uses which simultaneously classified as creative for one object and as traditional for another one. This condition was met by 29 uses within our item pool. To validate that participants would share our conception of creative and traditional uses, we conducted three pilot studies for which we recruited participants via Prolific. First, we asked five individuals (self-reported gender identity: 3 females, 2 males; age: $M = 24.4$, $SD = 6.2$ years; nationalities: UK, Latvia, USA, Estonia, Poland) to rate the creativity of both possible uses for each object. In each trial, they only saw one combination of object and use, and they should rate the creativity of this use for the given object by moving a visual slider going from “Very traditional” to “Very creative”. Responses were scaled on a range from 0 to 100. While objects were presented as images, uses appeared in written form. In total, there were 84 combinations of objects and uses, presented in random order. For each object, creative uses were evaluated as more creative than traditional uses (creative: $M = 74.46$, $SD = 10.72$; traditional: $M = 5.76$, $SD = 5.21$; minimal rating difference: 15.8).

Next, we recruited five new individuals (self-reported gender identity: 4 females, 1 male; age: $M = 24.8$, $SD = 1.8$ years; nationalities: Greece, South Africa, UK, Italy, Poland), who conducted a similar study but instead of evaluating creativity on a scale we asked them in each trial to either select the creative or the traditional use. In contrast to the main studies, participants were not instructed to respond as fast as possible. We excluded all items for which the share of correct responses (i.e., selecting the requested use) was below 90%. We also removed all objects for which none of both uses classified as the respective counterpart (creative or traditional use) for

another object. Finally, we ended up with 20 objects, among which 14 uses were presented in both conditions. We then repeated the second pilot study with the reduced object pool and a new sample of five individuals (self-reported gender identity: 2 females, 3 males; age: $M = 21.2$, $SD = 2.9$ years; nationalities: Portugal ($n = 3$), Poland, Hungary), resulting in an average share of correct responses of 94.00% ($SD = 3.35\%$).

Table S1.

Item	Traditional use	Creative use
Books	Read	Put stuff on top
Bottle	Drink water	Put flowers inside
Bowl	Eat muesli	Draw circles
Box	Store stuff inside	Eat muesli
Candle	Create light	Heat food
Chair	Sit down	Climbing up
Corkscrew	Uncork a bottle	Drill a hole
Crum	Drumming	Sit down
Cutlass	Fencing	Uncork a bottle
Golf club	Play golf	Weed the garden
Hat	Wear on your head	Dim the light
Headphones	Listen to music	Tie your shoes
Lampshade	Dim the light	Wear on your head
Pot	Heat food	Drumming
Shield	Take cover behind	Sledding
Shoelaces	Tie your shoes	Tie up the hair
Shovel	Dig a hole	Play golf
Spoon	Eat soup	Dig a hole
Table	Put stuff on top	Take cover behind
Vase	Put flowers inside	Drink water

Table S1. Items and uses for both experiments. Pictures of each item can be found on the OSF (<https://osf.io/mwyp7/>).

Experiment 1: Supplementary results

Following our main analyses, MT and AUC were significantly higher for trials in which the creative use was selected, MT: $F(1, 34) = 15.07, p < .001, \eta_p^2 = .31$; AUC: $F(1, 34) = 10.68, p = .002, \eta_p^2 = .24$. The same descriptive but non-significant trend was present for ITs, $F(1, 34) = 3.91, p = .056, \eta_p^2 = .10$. IT and MT significantly decreased during the experiment (IT: $F(1, 34) = 32.43, p < .001, \eta_p^2 = .49$; MT: $F(1, 34) = 22.87, p < .001, \eta_p^2 = .40$) while AUC did not change over time, $F < 1$. We did not observe any significant interaction, $F_s < 1$.

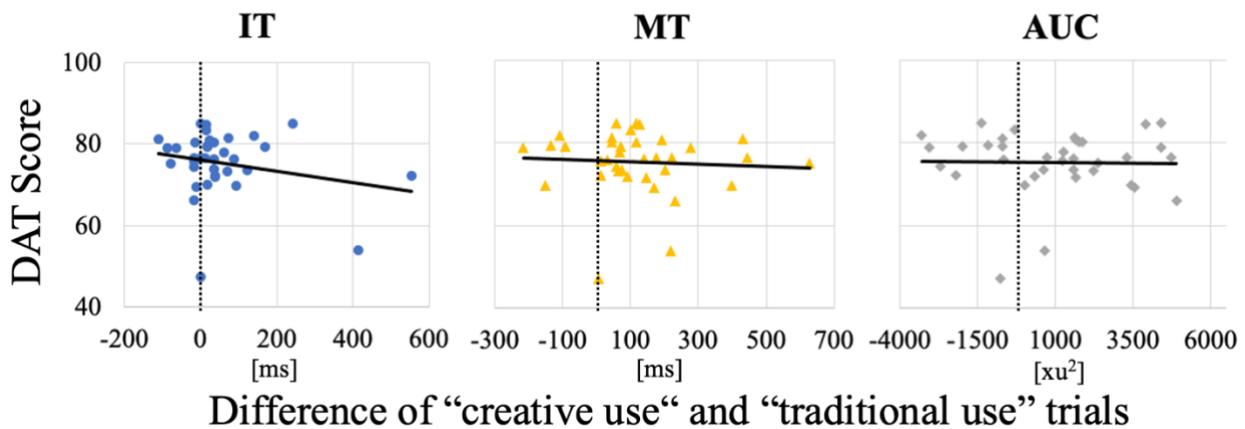


Fig. S1. Correlation of the individual score in the divergent association task (DAT Score) and the difference of “creative use” and “traditional use” trials for Initiation Time (IT, blue circles), Movement Time (MT, orange triangles), and Area Under the Curve (AUC, grey diamonds) in Experiment 1. The DAT score refers to the transformed average of the semantic distances between the first seven valid responses out of the ten entered words (see for details Olson et al., 2021). Each shape represents one participant. Vertical, dotted lines represent zero and solid, black lines show linear regression lines.

Table S2.

	Error	< 3 data points	IT	MT	AUC	2.5 <i>SD</i>	Sum
Creative	3.85	< 0.01	2.55	0.37	0.93	1.76	9.46
Traditional	16.99	0.05	3.24	0.20	1.10	2.94	24.51
Overall	20.83	0.05	5.78	0.56	2.03	4.71	33.97

Table S2. Data exclusions (in % of all trials) for each exclusion criterion and both item use conditions within Experiment 1. These values refer to the whole sample of 51 participants (overall exclusion rate for the final sample of 36 participants: 26.42%).

Table S3.

	Traditional Use	Creative Use	
Traditional Task	46.32	3.85	50.17
Creative Task	16.99	32.84	49.83
	63.31	36.69	100

Table S3. Average share (in %) of creative and traditional selections for initial tasks and eventual mouse clicks (i.e., uses) as well as for each combination of both within Experiment 1.

Table S4.

Item use	IT (ms)		MT (ms)		AUC (xu^2)	
	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2
Traditional	475.50 (245.09)	362.26 (203.26)	862.66 (273.93)	757.65 (278.59)	9,199.29 (3,040.90)	9,360.66 (2,834.38)
Creative	516.80 (269.01)	400.29 (250.29)	1,021.50 (332.58)	854.06 (285.33)	10,731.67 (3,721.77)	10,365.36 (3,281.43)

Table S4. Means (standard deviations in brackets) of Initiation Time (IT), Movement Time (MT), and Area Under the Curve (AUC) for both item use conditions and both blocks within Experiment 1.

Experiment 2: Method and results

Method

Participants

The sample size of 51 participants followed the same power calculation as for Experiment 1. Again, we did not analyze data of participants with less than 10 valid trials per condition. This applied to 5 individuals, leading to a final sample size of 46 participants (self-reported gender identity: 19 females, 26 males, 1 diverse; age: $M = 25.9$, $SD = 8.2$ years). Similar to Experiment 1, participants reported their gender identity by selecting one of four predetermined options (female, male, diverse, prefer not to say). Effective power for the final sample was $1-\beta = 80\%$ for effect sizes of $d_z = 0.42$ and above. Participants reported a total of 14 nationalities, the most common were Poland ($n = 14$), the UK ($n = 7$) and Portugal ($n = 6$). Information on nationality was entered in a free-response box.

Materials and Procedure

Which use participants should select in a specific trial was indicated by a bold, uppercase letter presented within the home area in each trial (“C” for creative task and “T” for traditional task). Both options appeared similarly often across the experiment in random order.

Data analysis

Pre-processing steps, criteria for data exclusions, and all analyses were the same as for Experiment 1. Accordingly, trials in which participants did not click on the assigned use were

excluded from the analysis (i.e., when they clicked on the creative use although they had been assigned the traditional one and vice versa). In total, we excluded 20.71% of all trials (see Table S5).

Results

Figure S2 shows click frequencies (pie chart) and time normalized movement trajectories for creative and traditional responses. Participants clicked on significantly more traditional than creative uses (click frequencies: creative: $M = 42.33\%$, $SD = 13.60\%$; traditional: $M = 57.67\%$, $SD = 13.60\%$), $t(50) = 4.03$, $p < .001$, $d_z = 0.56$; 95%- CI_{SM} [0.27, 0.86] and committed more errors for creative responses by clicking on the traditional option than vice versa (see Table S5; accuracy: overall: $M = 88.01\%$, $SD = 14.67\%$; creative: $M = 80.34\%$, $SD = 27.45\%$; traditional: $M = 95.69\%$, $SD = 6.86\%$), $t(50) = 4.03$, $p < .001$, $d_z = 0.56$; 95%- CI_{SM} [0.27, 0.86]. IT and MT were significantly higher for creative than for traditional responses (IT: creative: $M = 407.48$ ms, $SD = 266.55$ ms, traditional: $M = 388.27$ ms, $SD = 246.04$ ms; MT: creative: $M = 919.72$ ms, $SD = 312.73$, traditional: $M = 821.15$ ms, $SD = 264.49$ ms), IT: $t(45) = 2.17$, $p = .035$, $d_z = 0.32$, 95%- CI_{SM} [0.02, 0.61]; MT: $t(45) = 3.57$, $p = .001$, $d_z = 0.53$, 95%- CI_{SM} [0.21, 0.83]). The same held true for AUC (creative: $M = 11,209.33$ xu^2 , $SD = 2,682.87$ xu^2 ; traditional: $M = 9,652.41$ xu^2 , $SD = 2,580.16$ xu^2), $t(45) = 5.15$, $p < .001$, $d_z = 0.76$, 95%- CI_{SM} [0.43, 1.08].

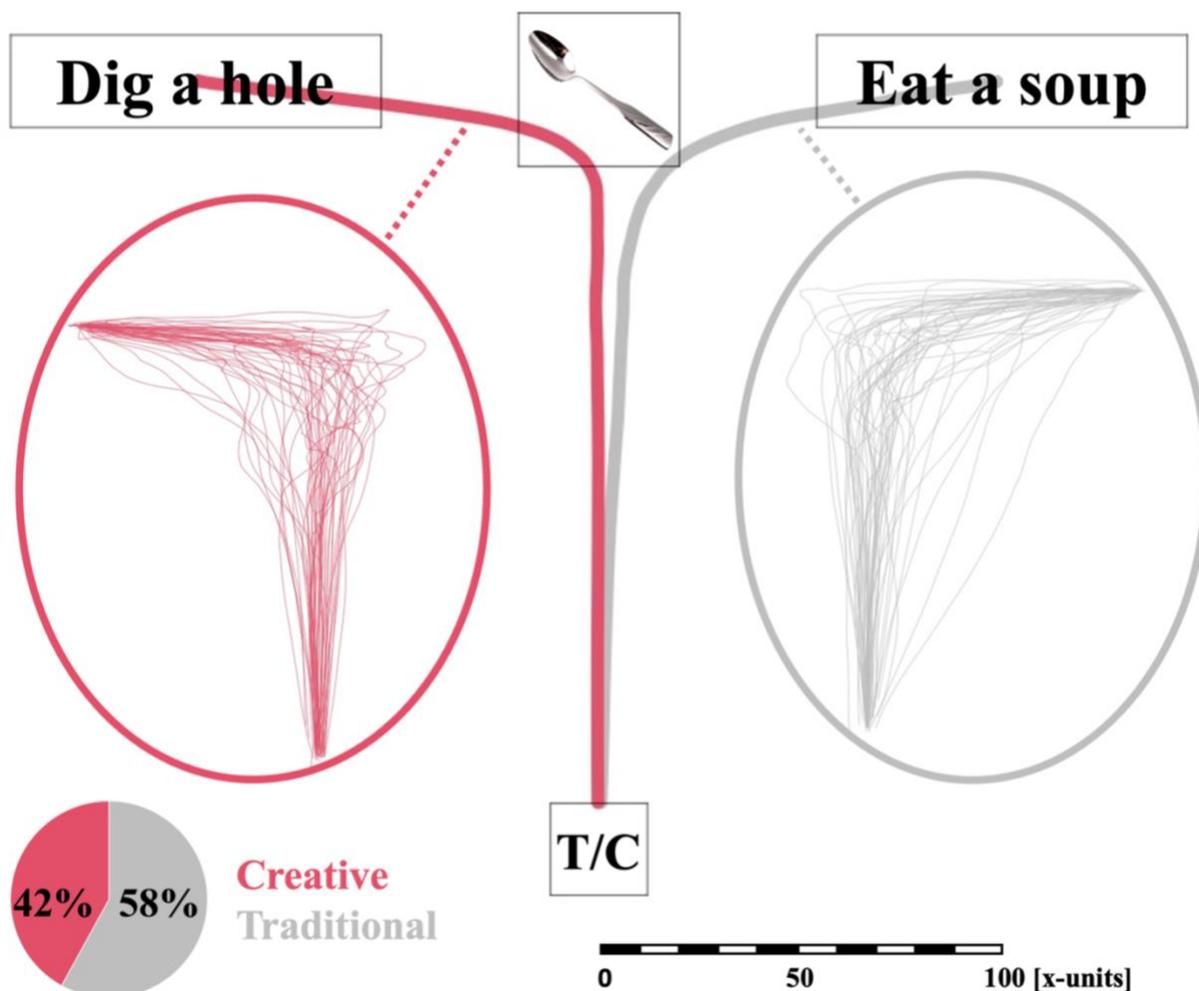


Fig. S2. Click frequencies (pie chart) and time normalized movement trajectories for Experiment 2. Participants were prompted to click either on a creative use (here: “Dig a hole”) or a traditional use (here: “Eat a soup”) for a given item (here: spoon). Which use should be clicked on was indicated by a bold letter within the home area (“T” for traditional, “C” for creative). When moving towards the creative use (dark red line), trajectories were significantly more biased towards the traditional option than in the reversed case (light grey line). Thin lines represent average trajectories of each single participant for both item use conditions.

Table S6 shows means and standard deviations of IT, MT, and AUC for each item use condition as well as for both blocks within the experiment. In line with our main analyses, MT and AUC were significantly higher for trials in which the creative use was clicked, MT: $F(1, 45) =$

13.41, $p = .001$, $\eta_p^2 = .23$; AUC: $F(1, 45) = 22.07$, $p < .001$, $\eta_p^2 = .33$. For IT, we observed a descriptively similar, however statistically nonsignificant difference, $F(1, 45) = 3.43$, $p = .071$, $\eta_p^2 = .07$. AUC significantly increased from the first to the second block within the study, $F(1, 45) = 6.00$, $p = .018$, $\eta_p^2 = .12$. In contrast, IT significantly decreased over time, $F(1, 45) = 27.05$, $p < .001$, $\eta_p^2 = .38$; whereas MT did not change over time, $F(1, 45) = 2.75$, $p = .104$, $\eta_p^2 = .06$. We did not observe any significant interaction, $F_s < 1$. For none of our dependent variables, the difference of “creative use” and “traditional use” trials correlated with the individual score in the divergent association task (see Fig. S3), $|rs| \leq .28$, $|ts| \leq 1.92$, $ps \geq .061$. Descriptively, the largest correlation emerged for DAT score and IT differences. Albeit not being significant, this pattern might warrant follow-up work with larger sample sizes and thus better power for correlational analyses.

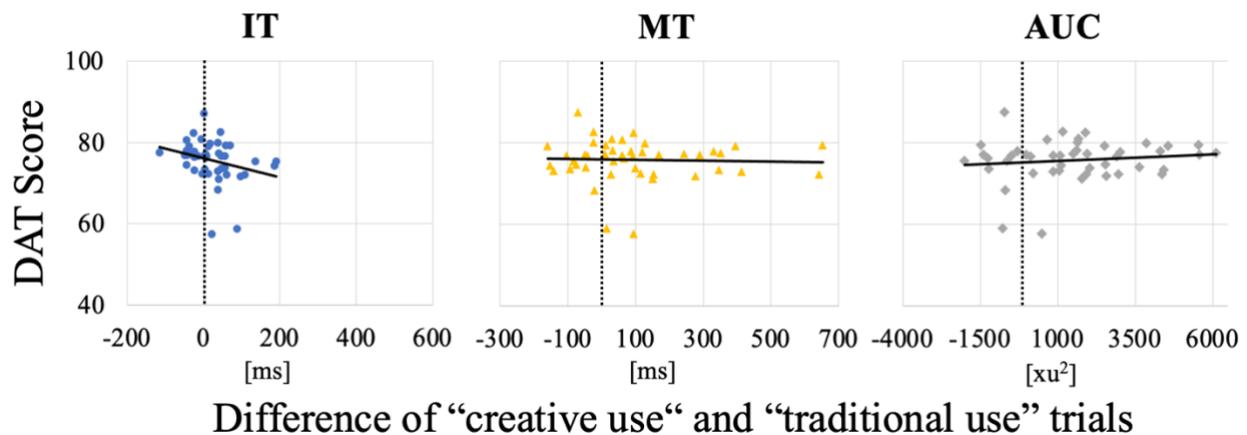


Fig. S3. Correlation of the individual score in the divergent association task (DAT Score) and the difference of “creative use” and “traditional use” trials for Initiation Time (IT, blue circles), Movement Time (MT, orange triangles), and Area Under the Curve (AUC, grey diamonds) in Experiment 2. The DAT score refers to the transformed average of the semantic distances between the first seven valid responses out of the ten entered words (see for details Olson et al., 2021). Each shape represents one participant. Vertical, dotted lines represent zero and solid, black lines show linear regression lines.

Table S5.

	Error	< 3 data points	IT	MT	AUC	2.5 SD	Sum
Creative	2.16	< 0.01	1.62	0.54	1.45	2.16	7.92
Traditional	9.83	< 0.01	2.11	0.37	1.10	2.99	16.40
Overall	11.99	< 0.01	3.73	0.91	2.55	5.15	24.31

Table S5. Data exclusions (in % of all trials) for each exclusion criterion and both item use conditions within Experiment 2. These values refer to the whole sample of 51 participants (overall exclusion rate for the final sample of 46 participants: 20.71%).

Table S6.

Item use	IT (ms)		MT (ms)		AUC (xu ²)	
	Block 1	Block 2	Block 1	Block 2	Block 1	Block 2
Traditional	456.93 (306.57)	328.24 (211.33)	850.48 (342.37)	799.11 (260.76)	9,179.44 (2,789.36)	10,129.10 (3,051.50)
Creative	468.38 (328.29)	351.65 (237.77)	946.11 (360.57)	903.49 (303.86)	10,893.01 (3,518.72)	11,608.32 (3,146.94)

Table S6. Means (standard deviations in brackets) of Initiation Time (IT), Movement Time (MT), and Area Under the Curve (AUC) for both item use conditions and both blocks within Experiment 2.

Between-experiment comparison

We investigated the influence of volitional choice on cognitive conflict in creative behavior by comparing the results of both experiments (Experiment 1: free choice; Experiment 2: forced choice). Therefore, we conducted an ANOVA for each dependent variable (IT, MT, AUC), using item use (traditional vs. creative) as a within-subjects factor and experiment (free choice vs. forced choice) as a between-subjects factor. For each dependent variable, the main effect of item use paralleled our main findings, $F_s \geq 10.72$, $p_s \leq .002$, $\eta_p^2_s \geq .12$, and there was no main effect of experiment for any measure, $F_s \leq 1$. Importantly, we further did not observe any interaction of item use and experiment, $F_s \leq 2.71$, $p_s \geq .104$, $\eta_p^2_s \leq .03$.