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Sticky tradition impedes selection of creative ideas

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Abstract

Creativity is a driving force for human development and has fascinated scholars for centuries. Surprisingly little is known about the cognitive underpinnings of putting creative ideas into action, however. To shed light on this part of the creative process, we tracked how hand movements unfolded when choosing between either a traditional or a creative use of a given object. Participants could freely decide between both options (Experiment 1, N = 51 adults) or were prompted to select a specific use (Experiment 2, N = 51 adults). Temporal as well as spatial measures of action unfolding revealed behavior to be strongly biased towards traditional options when choosing an available, more creative option eventually. Creative behavior thus comprises two obstacles: not only coming up with new ideas, but also overcoming a lasting bias towards using old ones.

Keywords: creativity, innovation, cognitive control, motion-tracking, response dynamics

Public Significance Statement

We show that creativity takes more than just coming up with an original idea. Even after deciding on creative options, human behavior is strongly biased towards traditional approaches. This lasting effect of established beliefs and procedures might explain why creative ideas are often discarded rapidly and why so many innovative projects fail in an early stage. Focusing on ways to overcome the sticky nature of traditions thus has direct implications for the design of environments and interventions that should promote creative ideas and behavior.

Creativity is the driving force of social upswing and scientific discovery (Hennessey & Amabile, 2010). Promoting creative ideas thus is a key goal for academia, organizations, and society at large (Andriopoulos, 2001; Cropley, 1997; Heinze et al., 2009). Creativity does not come easy, however, and the constraints of the human cognitive system that hamper innovation have been puzzling (Beaty et al., 2016).

Coming up with original solutions is traditionally construed as the evident obstacle for creativity (Adams et al., 2021; Amabile, 1988). As observed in so-called functional fixedness problems, creative insight is hampered by established associations to known objects (Duncker, 1945; McCaffrey, 2012). In line with such reasoning, participants performed better in these tasks when being blindfolded (Glucksberg, 1964), suggesting that diversion of attention can help to countermand retrieval of the traditional object use (see also Tucker & Ellis, 2001).

Here we propose that biases towards traditional options go beyond the generation of unconventional ideas and may extend towards the selection and implementation of a creative solution. As previously shown, idea generation is necessary but not sufficient for successful creative behavior (e.g., Rietzschel et al., 2010), and people sometimes even fail to select creative ideas when choosing from a pool of potential options (Faure et al., 2004). By precisely targeting the crucial role of idea selection within the creative process, this research closes an important gap in theorizing on creativity.

Seeing creativity as comprising a tug-of-war between traditional and original solutions suggests that creativity might be linked to executive functions, i.e., cognitive control (e.g., Beaty et al., 2016; Benedek et al., 2012; De Dreu et al., 2012; Radel et al., 2015). This link is not simple, however, but remarkably nuanced (Chrysikou, 2018). On the one hand, overly strong control seems to hamper idea production so that disrupting executive functions was found to improve performance in open-ended object-use tasks (Chrysikou et al., 2013). On the other hand, cognitive control facilitates the evaluation and selection of generated solutions

(Mayseless et al., 2015). Moreover, exercising cognitive control to overcome a lasting bias towards traditional options might constitute another distinct constraint in creative cognition. Crucially, this bias might even be effective after the decision to choose a creative option has already been made.

To test this hypothesis, we created a response-dynamics paradigm (McKinstry et al., 2008; Pfister et al., 2016) in which participants could choose between creative or traditional uses for given objects. Participants chose one out of two uses for a visually presented object by moving a mouse cursor towards a left or right target area on the computer screen. In Experiment 1, participants could freely decide between both options while in Experiment 2 they were prompted to select a specific use. Movement trajectories while selecting a target position are a prime measure to detect potential attraction towards specific response options (Dale & Duran, 2012; Duran et al., 2010; Freeman & Ambady, 2009; Song & Nakayama, 2008; 2009; Spivey et al., 2005; Wirth et al., 2020). We predicted responses to show residual attraction to the traditional use, even when aiming towards the creative solution, whereas any bias towards the opposing response option should be less pronounced when opting for the traditional use. Two preregistered experiments (51 adult participants each) yielded converging evidence for this hypothesis. Experiment 1 is reported in full below, whereas detailed information for Experiment 2 is presented in the supplemental material. All procedures performed in this study were approved by the Ethics Committee of the Institute for Psychology of the Julius-Maximilians-University of Würzburg (GZEK 2021-52).

Method

Transparency and openness

Raw data, materials, and analysis syntax are available on the Open Science Framework (https://osf.io/mwyp7/). Both studies were preregistered (Experiment 1: https://osf.io/6cy5m/?view_only=912b74c107cf44ddb6ff3134dfb16447; Experiment 2: https://osf.io/vfwst/?view_only=9ff66148c8c447a68e1156c855c564c0).

Experiment 1

Participants

Because a priori estimates of potential effect sizes were not available in the literature, we based our sample size calculations on a small effect size of $d_z = 0.40$, resulting in a sample size of 51 participants for a power of $1\text{-}\beta = 80\%$ ($\alpha = .05$, two-tailed testing; calculated with the power.t.test function in the statistics package R, version 4.0.3). We excluded data of participants with less than ten valid trials per condition ($n = 15$), which led to a final sample size of 36 participants (15 females, 20 males, 1 preferred not to answer; age: $M = 28.9$, $SD = 14.3$ years). Participants indicated their gender identity by selecting one of the following four options: female, male, diverse, prefer not to say. Effective power for the final sample was $1\text{-}\beta = 80\%$ for effect sizes of $d_z \geq 0.48$.

Participants were recruited via Prolific. They reported 15 different nationalities in total, among which Poland ($n = 10$), South Africa ($n = 7$), and the UK ($n = 3$) were mentioned most frequently (responses were entered in a free-response box).

Materials and Procedure

For our stimuli we used pictures of 20 objects, each with one creative and one traditional use (see Table S1). These uses were selected based on extensive pilot work to ensure that they fulfilled a widespread definition of creativity (Runco & Jaeger, 2012) in terms of originality and effectiveness (see supplemental material for details).

Experiment 1 was conducted online and programmed with lab.js (Henninger et al., 2022; Kieslich & Henninger, 2017). All participants received detailed instructions beforehand and provided informed consent. The study was programmed against a reference screen size of 800 x 600 px and scaled to match the individual display resolution of each participant. All distances reported in the following refer to this reference screen size. Before each trial, participants indicated whether they intended to choose the creative or the traditional use for the following object (see Fig. 1). The corresponding screen showed two boxes containing the statements “Traditional task” and “Creative task”. The order of both boxes was determined randomly for each participant, but it was constant across the entire session. Participants indicated their choice by clicking on the corresponding box. Next, participants had to click on a small black square in the middle of the screen to center the position of the mouse cursor. The following screen displayed a home area (60 px x 60 px) in the bottom center and two target areas (230 px x 30 px) in the upper left and upper right side of the screen, respectively. The middle of the target area showed a bold uppercase letter, which indicated the chosen use for the given trial (“C” for creative use, “T” for traditional use). One use was shown in each target area, while the position of the traditional and the creative use was determined randomly in each trial. The target object was presented in the middle of both target areas (bounding box: 100 px x 100 px). To start each trial, participants had to click on the home area. Only then the target object appeared, and participants were to move the mouse cursor to the chosen use as fast as possible. We measured the time from target stimulus onset until the mouse cursor had left the home area (Initiation Time, IT). To get rid of potential dwelling time within the target areas, Movement Time (MT) was defined as the time from leaving the home area until approaching the center of one of both target areas to less than 20 px. Movement trajectories were tracked by sampling x- and y-coordinates of the mouse cursor. We did not present any feedback and the next trial started directly after participants had clicked on one of both target areas.

There were two blocks of 40 trials each. Every item was presented twice per block in randomized order. At the end of the experiment, participants conducted the divergent association task (DAT) as a measure of verbal creativity (Olson et al., 2021). Therein, participants had four minutes to come up with ten words as different from each other as possible, regarding all uses and meanings.

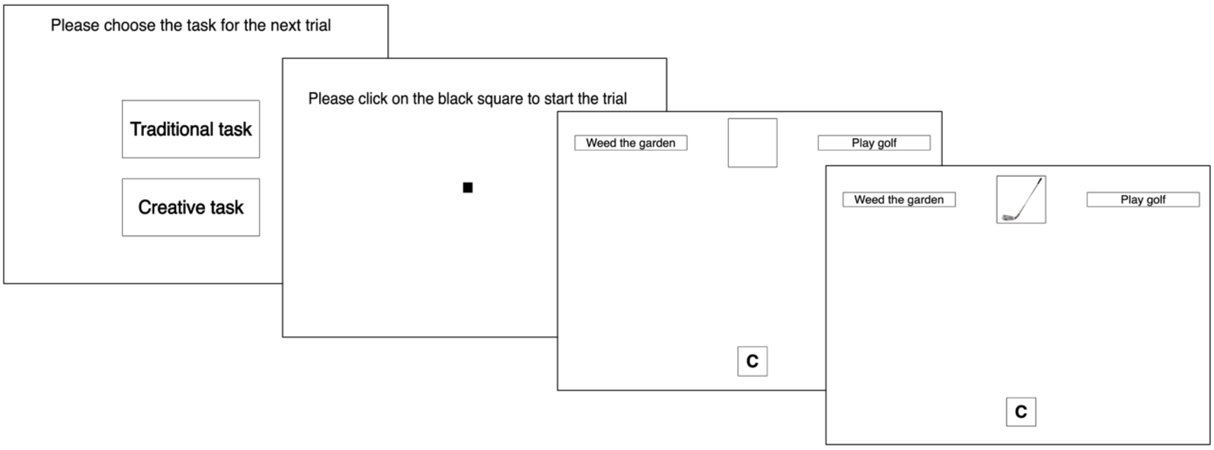

Fig. 1. Trial procedure. Participants indicated whether they wanted to select a traditional or a creative use for an upcoming object. They then had to click on a small, black square in the middle of the screen. This click made two potential uses appear (target areas), accompanied by a home area in the bottom center of the screen. Moving the mouse cursor to the home area made the object appear between both target areas. Finally, participants had to move the cursor to the chosen use as fast as possible and had to click on the corresponding option.

Data analysis

We pre-processed trajectory data using custom R scripts. To account for varying screen sizes, we scaled all trajectories to a uniform display resolution so that the distance from the center of the home area and each target area was 100 x-units (xu) on the x-axis and 200 xu on the y-axis. We mirrored all left-going movements at the vertical midline and then time-normalized the trajectories from movement onset to reaching the target area to 101 points using linear interpolation. To compensate for varying click times, we appended the last coordinate of the movement after time normalization. The Area Under the Curve (AUC) was determined as the signed area between these points and a straight line from start- to endpoint of the scaled movement (in xu^2). We did not analyse error trials (i.e., selecting the creative use when intending to select the traditional use and vice versa), trials with less than three data points (as otherwise no meaningful trajectory could be determined), as well as trials with extremely high or low values for one of the measures (IT > 3,000 ms, MT > 5,000 ms, AUC > 30,000 xu^2, and AUC < -20,000 xu^2).[1] Trials following error trials were included in the analyses due to the unexpectedly high number of erroneous responses. After applying these fixed filters, we additionally excluded trials in which IT, MT or AUC deviated more than 2.5 SD from their corresponding cell mean. In total, we excluded 26.42% of all trials (see Table S2).

For each measure (choice frequency, IT, MT, AUC), we calculated a two-tailed *t*-test comparing trials in which the creative use was selected to trials in which the traditional use was selected. Note that the analysis of choice frequencies is based on data before any

[1] Note that the latter selection criteria were not preregistered. Visual inspection of the raw data, however, suggested this procedure because such outlier data might distort the following exclusion criterion of +/- 2.5 SD (see Van Selst & Jolicoeur, 1994).

exclusions. To investigate potential changes across the duration of the study, we computed an exploratory repeated-measures analysis of variance for each dependent variable, with item use (creative vs. traditional) and experimental block (first vs. second) as within-subject factors. Finally, we calculated the difference of "creative use" and "traditional use" trials for each dependent variable (positive differences indicate higher values for creative than traditional uses) and correlated these differences with the individual DAT score.

Experiment 2

For Experiment 2, we collected a new sample of 51 participants. The stimuli, experimental procedure, criteria for data exclusions and all analyses were similar to Experiment 1, except that we asked participants to select a specific item use in each trial (see supplemental material for details).

Results

Experiment 1

Figure 2A shows the resulting movement trajectories and choice frequencies (share of trials in which the creative or traditional use was eventually selected by mouse click) for creative and traditional solutions. Choice frequencies indicated a consistent preference for selecting traditional over creative responses (see Table S3; creative: M = 36.69%, SD = 19.57%; traditional: M = 63.31%, SD = 19.57%), $t(50) = 4.86$, $p < .001$, $d_z = 0.68$, 95%-CI_{SM} [0.37, 0.98]. Furthermore, participants committed significantly more errors for creative responses by clicking on the traditional option than vice versa (see Table S2; accuracy: overall: M = 79.17%, SD = 20.53%; creative: M = 65.40%, SD = 36.04%; traditional: M =

91.68%, SD = 8.14%)[2], $t(50) = 5.36$, $p < .001$, $d_z = 0.75$. Importantly, this bias endured when assessing how each response was enacted. Even when participants decided on the creative option, movement initiation and execution showed a persistent influence of the traditional use as shown in Figure 2B. That is, movements towards creative uses were initiated slower, $t(35) = 2.55$, $p = .015$, $d_z = 0.42$, 95%-CI_{SM} [0.08, 0.76], and performing the movement required more time compared to trials in which the traditional use was selected, $t(35) = 4.13$, $p < .001$, $d_z = 0.69$, 95%-CI_{SM} [0.32, 1.05]. Most notably, trajectories for creative responses were torn towards the traditional use more strongly than vice versa (see Fig. 2A). This resulted in a significantly larger area between the trajectory and a straight line from start- to endpoint of the movement for creative responses compared to traditional ones (AUC; creative: M = 10,423.65 xu^2, SD = 2,657.30 xu^2; traditional: M = 9,457.05 xu^2, SD = 2,584.25 xu^2), $t(35) = 2.57$, $p = .015$, $d_z = 0.43$, 95%-CI_{SM} [0.08, 0.77]. Figure 2C shows effect sizes for the comparison of creative and traditional responses for each measure.

[2] Please note that in contrast to our preliminary studies, participants were instructed to respond as fast as possible.

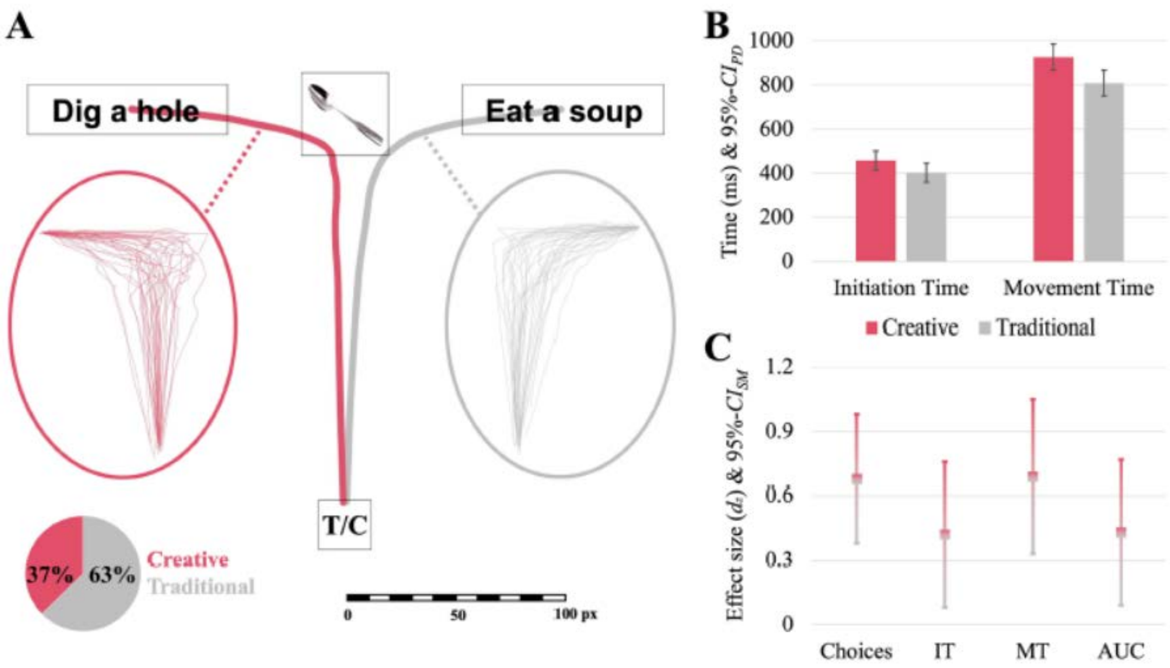

Fig. 2. Study design and main results. (A) Experimental setup, choice frequencies of the selected uses (pie chart) and time normalized movement trajectories. Participants could choose between a creative use (here: “Dig a hole”) and a traditional use (here: “Eat a soup”) for a given item (here: spoon). When opting for the creative use (dark red line), trajectories were biased more strongly 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. (B) Initiation Time and Movement Time for creative and traditional responses. Error bars represent 95% confidence intervals of the paired differences (Pfister & Jancyzk, 2013). (C) Effect sizes (d_z) for the comparison of “traditional use” and “creative use” trials for choice frequencies (Choices), Initiation Time (IT), Movement Time (MT), and Area Under the Curve (AUC). Error bars indicate 95% confidence intervals of the standardized means.

Table S4 in the supplement shows means and standard deviations for IT, MT and AUC for each item use condition and both blocks within the experiment. For none of our dependent variables the effect of item use condition changed significantly during the experiment (see supplementary results). Moreover, the difference of “creative use” and “traditional use” trials did not correlate with the individual DAT score for any dependent variable (see Fig. S1), $|rs| \leq .23$, $|ts| \leq 1.38$, $ps \geq .177$.

Experiment 2

Regarding all analyses, the pattern mirrored the results observed in Experiment 1. Thus, ITs and MTs were longer for creative than for traditional solutions, and AUCs indicated movements to be deflected towards traditional options when eventually clicking on a creative one ($ps \leq .035$). Moreover, a direct comparison of both experiments did not reveal any systematic differences in the strength of these effects. Detailed results are available in the supplemental material.

Discussion

Why do human agents hardly ever deviate from their established beliefs and procedures? In two experiments, we studied this question by tracking hand movements while participants chose between traditional or creative uses for given items. We found a consistent preference for traditional over original options. Crucially, even when going for the creative solution eventually, behavior was strongly torn towards the traditional approach as revealed by spatial and temporal features of the corresponding movement trajectories. This effect held true irrespective of whether participants voluntarily decided on the creative solution or whether they were externally instructed to go for the creative approach.

The present observations highlight a distinct obstacle to creative behavior that is at work even after creative solutions have become known. We suggest that this obstacle is rooted in the human predisposition to follow various kinds of rules and norms by default (Baum et al., 2004; Pfister et al., 2016). This includes arbitrary rules and official regulations, but importantly also social norms arising from traditional beliefs and procedures. Deviating from any kind of rule or norm thus seems to require substantial cognitive control to suppress dominant action tendencies (Beaty et al., 2016; Pfister et al., 2019).

The strength of this bias is further highlighted as this effect did not differ between initial and later choices of the same behavior and was not related to verbal creativity in the DAT. However, this task focuses on idea generation and relies on verbal material, whereas our experiments address idea selection and object-directed interactions. The absence of a relation between both measures, thus, highlights that idea generation and selection constitute mainly independent stages within the creative process (Faure et al., 2004).

A consistent pull towards traditional ideas might further explain why people often reject creative solutions of other agents, particularly in organizational contexts (Staw, 1995). Along the same lines, the sticky nature of tradition can lead to a hasty discarding of an original idea in face of any problems, therefore playing a major role in the frequent and rapid failure of innovative approaches (Asplund & Sandin, 1999; Cozijnsen et al., 2000). Critically, it is precisely these innovations that have brought significant progress to society in the past and that will also be necessary for future development. The present results highlight that adopting an agent-centred perspective on creative cognition helps understanding and thus promoting creative ideas and behavior.

Constraints on Generality

Our results provide compelling evidence that human behavior is strongly torn towards traditional approaches. At the same time, not all individuals seem to experience such a cognitive bias against creativity, with substantial interindividual variation in average trajectories (see Fig. 2A). Because the target population of our study were adult internet users, who are fluent in English, future research should address inter-individual and cross-cultural differences as well as potential relations to other facets of creativity like convergent thinking and creativity in object use. A further limitation might be that the presented uses were externally provided and not generated by the participants themselves, which might play a role as own ideas might be judged as more creative than ideas brought up by other people.

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