National Defence University

Department of Military Technology

International LUMAT Symposium 2019 in Jyväskylä, Finland, on June 5th – 6th

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How Artificial Intelligence can support creativity in learning process?

The Finnish Defence Forces
Puolustusvoimat • Försvarsmakten

FT Kalle Saastamoine

Contents

- Preliminaries:
  - What is creativity?
  - What is computational creativity?
  - Where do they meet?
- Creativity in learning process
- Some existing AI teaching systems
- Conclusions

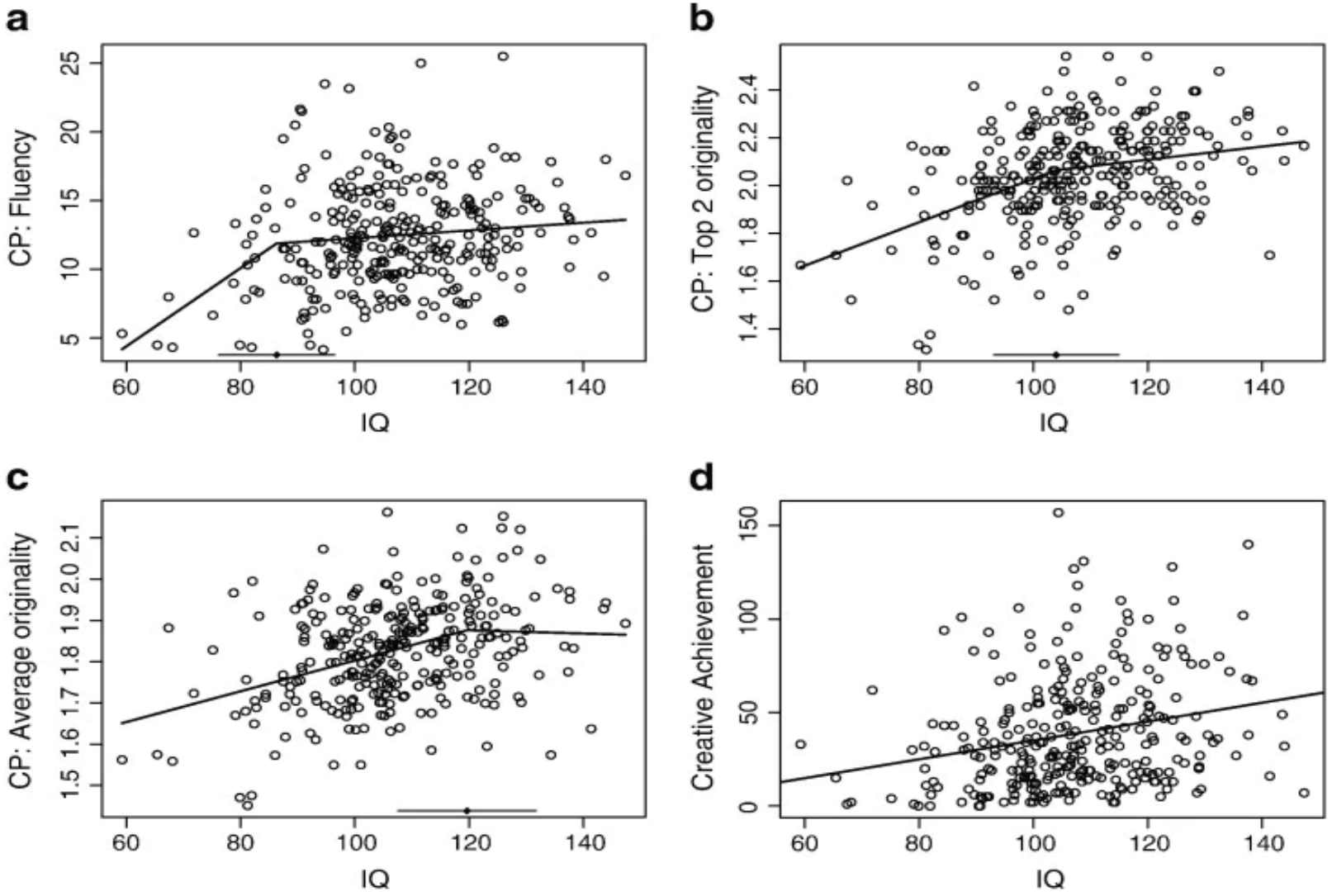
Creativity, Definitions

- “Creativity is the ability to transcend traditional ways of thinking or acting, and to develop new and original ideas, methods or objects.”, Kelly Morr
- “A product is creative when it is (a) novel and (b) appropriate. A novel product is **original not predictable**. The bigger the concept, and the more the product **stimulates further work and ideas**, the more the product is creative.”, Sternberg & Lubart, Defying the Crowd

More definitions

- ”**Creativity** is a concept of individual differences which is intended to explain why some people have higher potential to provide new solutions to old problems than others. It **leads us to change the way we think** about things and is conceived as the **driving force that moves civilization forward**.” (Hennessey & Amabile, 2010)
- **Creative potential** refers to the individual's **ability** to generate something novel and useful. (Sternberg & Lubart, 1999)
- **Creative achievement** refers to the **actual realization** of this potential in terms of real-life accomplishment. (Carson, Peterson, & Higgins, 2005)

Creativity and intelligence, n=297



Jauk, E., Benedek, M., Dunst, B. and Neubauer, A.C., 2013. The relationship between intelligence and creativity: New support for the threshold hypothesis by means of empirical breakpoint detection. Intelligence, 41(4), pp.212-221.

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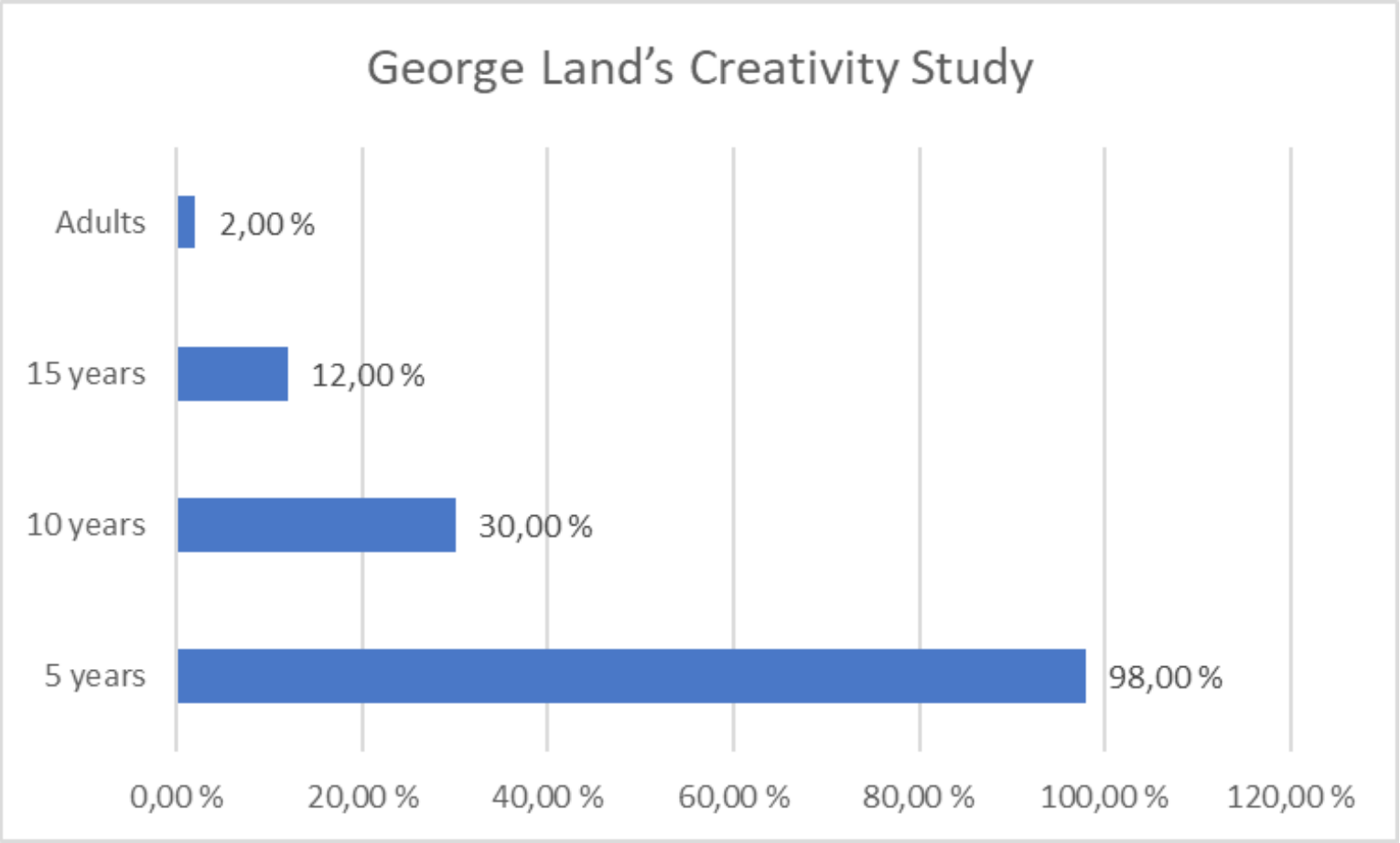
- For the criterion of ideational fluency (**number of ideas**), a breakpoint was detected at an IQ of 86.09 points. This breakpoint is statistically significant according to the Davies test for a change in the slope ($p < .05$; 95% CI = 75.57–96.61 points). The bivariate correlations (i.e., standardized βs) between intelligence and ideational fluency were $r = .56$ ($p < .01$, $n = 21$) below the breakpoint of 86.09 IQ points and $r = .09$ (ns, $n = 275$) above it. These correlations differed significantly according to Steiger's z-test ($z = 2.23$, $p < .05$). The breakpoint model is shown in Fig. 1a.
- For creative potential assessed by means of the Top 2 originality score, a significant breakpoint was detected at an IQ of 104.00 points ($p < .05$; 95% CI = 93.07–114.90 points). The bivariate correlations between intelligence and creative potential were $r = .38$ ($p < .01$, $n = 121$) below the breakpoint and $r = .14$ (ns, $n = 175$) above it and differed significantly ($z = 2.17$, $p < .05$). The scatter plot with the segmented relationship is shown in Fig. 1b.
- When the average originality was considered as a criterion, the breakpoint was estimated at an IQ of 119.60 points. This breakpoint, however, failed to reach statistical significance in the Davies test ($p = .14$; 95% CI = 107.5–131.7). Nonetheless, again, a significant correlation between intelligence and creative potential was obtained for the lower IQ range ($r = .35$, $p < .01$, $n = 232$), but not for the upper IQ range ($r = -.01$, ns, $n = 65$). These correlation coefficients were significantly different ($z = 2.62$, $p < .01$). Fig. 1c shows the scatterplot containing the segmented linear relationship.
- Finally, segmented regression analysis was also performed for the criterion of creative achievement (although no non-linear relationship was observed; see above). In line with the test of nonlinearity, no significant breakpoint was detected ($p = .64$). The linear model is shown in Fig. 1d.

Jauk, E., Benedek, M., Dunst, B. and Neubauer, A.C., 2013. The relationship between intelligence and creativity: New support for the threshold hypothesis by means of empirical breakpoint detection. *Intelligence*, 41(4), pp.212-221. Conclusions

- Quantitative criterion of ideational fluency we obtained IQ threshold of 86.09 points.
- Two most creative ideas in divergent thinking tasks (cf., Silvia et al., 2008), IQ threshold at 104.00 IQ points.
- Average originality of all ideas was considered, IQ threshold of 119.60.
- Intelligence may increase creative potential up to a certain degree where it loses impact and other factors come into play.
- For creative achievement, intelligence remains relevant even at the highest ability range.

Kids are more creative, (Land & Jarman, 1992)



- Evidence that children become less creative over time (and how to fix it), Professor George Land, TED talk

Why creativity goes away?

We teach kids to try and use two contractionary ways of thinking at the same time, which is impossible. (Professor George Land, TED talk)

1. **Convergent thinking (brake)**: where you judge ideas, criticise them, refine them, combine them and improve them, all of which happens in your conscious thought.
2. **Divergent thinking (accelerate):** where you imagine new ideas, original ones which are different from what has come before but which may be rough to start with, and which often happens subconsciously.

Creativity Killers and Creators

- Fear of judgement
- Fear of failure
- Apathy / boredom / depression / anxiety
- Lack of purpose

✓ Play is a powerful tool to overcome fears and anxiety

✓ Intrinsic Motivation: Autonomy (freedom), Mastery (skill development), Purpose

✓ Other tips: Physical excercises, Music, Daydreaming, Play with kids, Use best-case scenario thinking (think how things can go right instead of opposite)

Praise your three networks of the brain!

- **The executive attention network** helps you pay attention and focus
- **The imagination network** allows you to daydream or imagine yourself in someone else's shoes
- **The salience network** let's you identify when things you have buried deep in your brain are salient to the world around you (e.g. you're going for a hike and taking in the scenery, and you notice this plant… realize it looks familiar… and that it's poison ivy! And you just saved yourself from a terrible itchy rash.)
- The more **active** these networks are in your brain, and the more they **work together**, the more creative you are!

5 steps to optimize brain for discoveries

1. **Associating**: drawing connections between questions, problems, or ideas from unrelated fields
2. **Questioning**: posing queries that challenge common wisdom
3. **Observing**: scrutinizing the behavior of customers, suppliers, and competitors to identify new ways of doing things
4. **Networking**: meeting people with different ideas and perspectives
5. **Experimenting**: constructing interactive experiences and provoking unorthodox responses to see what insights emerge

Some views

- ”Forget artificial intelligence - in the brave new world of big data, it's artificial idiocy we should be looking out for.”, **Tom Chatfield**
- ”Before we work on artificial intelligence why don’t we do something about natural stupidity?”, **Steve Polyak**
- ”Nobody phrases it this way, but I think that artificial intelligence is almost a humanities discipline. It's really an attempt to understand human intelligence and human cognition.”, **Sebastian Thrun**

Computational creativity

- **Intersection** of artificial intelligence, cognitive psychology, philosophy, and the arts.
- **Goal** is to model, simulate or replicate creativity using a computer, to achieve:
  1. A program or computer capable of human-level creativity.
  2. Understand human creativity and to formulate an algorithmic perspective on creative behavior in humans.
  3. **Design programs that can enhance human creativity without necessarily being creative themselves.**

Process called evolutionary creative

1. **Collect:** learn from previous works stored in libraries, the Web, etc.;
   - Search engines Google etc.
2. **Relate:** consult with peers and mentors at early, middle, and late stages;
   - Artificial neural networks, Expert systems etc.
3. **Create:** explore, compose, evaluate possible solutions; and
   - Deep neural networks, semantic networks
4. **Donate:** disseminate the results and contribute to the libraries. (Shneiderman, 1999)

Combinatorial creativity

1. **Placing** a familiar object in an unfamiliar setting
2. **Blending** two superficially different objects or genres
3. **Comparing** a familiar object to a superficially unrelated and semantically distant concept
4. **Adding** a new and unexpected feature to an existing concept
5. **Compressing** two incongruous scenarios into the same narrative to get a joke
6. Using an iconic image from one domain in a domain for an unrelated or incongruous idea or product

Some existing AI teaching systems

1. Chatbots, able to have somewhat intellectual discussion.
2. Thinkster Math, uses AI to visualize the student's thinking process when he or she is working on a mathematical task.
3. Brainly, social network that uses AI to find correct students to work together.
4. Content Technologies Inc., uses Deep Learning, to create assemble custom textbooks.
5. Gradescope, AI assistance for grouping similar students answers together.

Google LLC.

- Most commonly used AI application.
- Able to profile users and adapt.
- Several different search options.
- Gmail, Calendar, Drive, Docs, Sheets, Slides, Photos, Keeps (notes), Translate, YouTube, Allo ja Duo (social media), Scholar, Android, News, Wallet, Alerts, DeepDream, AutoDraw, etc.

Final notes also called conclusions

- Teachers transform to tutors.
- New teaching systems will need constant maintenance.
- AI will become slowly a natural part of teaching.
- People might have problems in interpreting the data that AI creates.
- Most people do not want machines to educate kids alone.
- Big companies like Google will eat small ones.

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Conclusions

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THANK YOU, ANY QUESTIONS?