

Impact of Human-Artificial Intelligence Partnerships on Creativity

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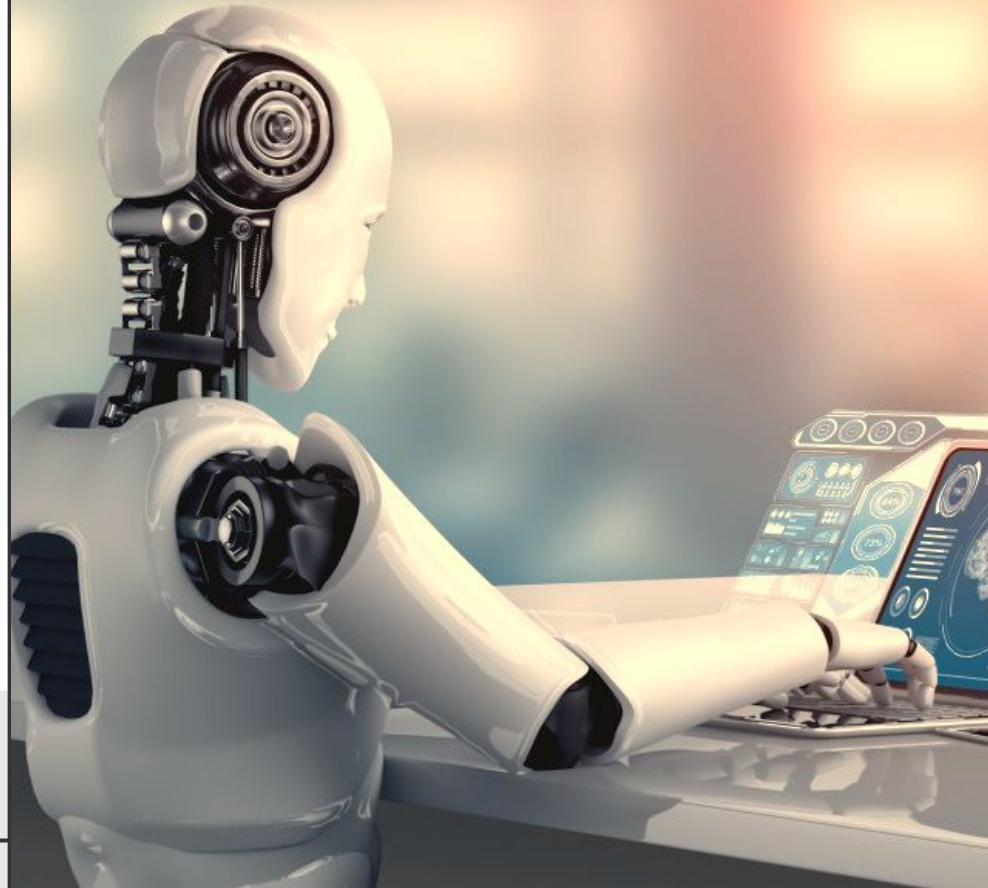
Q&A

01

Project Motivation

Knowledge Accumulation Strategies

1. Accumulate knowledge that AI already knows how to do
2. Accumulate knowledge outside of what AI knows to do



Creativity

“The generation of **novel** and **useful** ideas”
(Amabile, 1996)

AI Assistant

- GAI tools whose behavior is affected by its user
- Used by humans in **intimate, 1-1** settings



Galaxy AI ✨ is here

Research Question 1

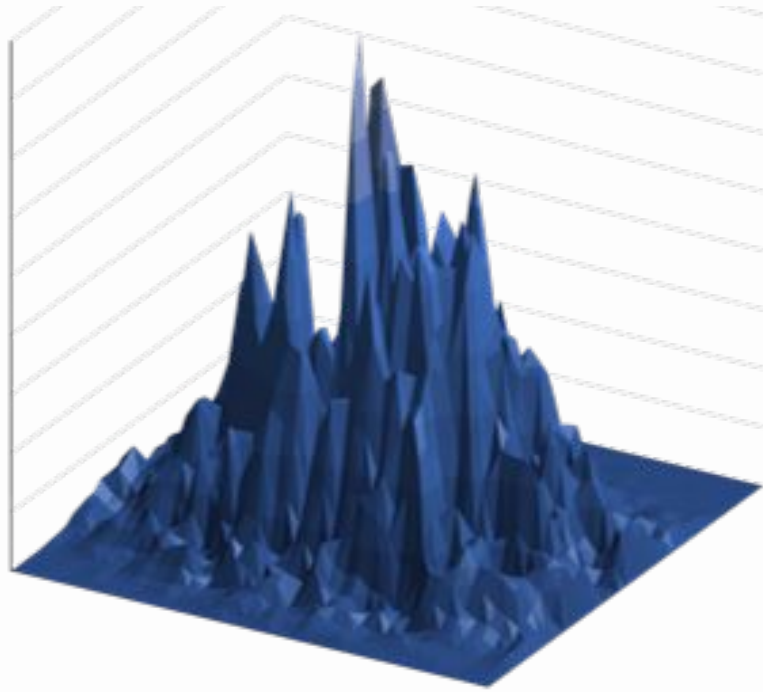
- How does the introduction of Human-AI partnerships affect the 1) usefulness and 2) novelty (or heterogeneity) of the ideas generated?

Research Question 2

- Under which human knowledge accumulation strategy can we induce higher levels of creativity (usefulness and novelty)?

02

Model



AI Assistants

Real-life

Pop musician is writing a song.
But, it tends to write similar songs based on its expertise and experience.

Abstraction

Humans are restricted by their **limited knowledge** and **bounded rationality**.

Model

Human Agents have a **restricted knowledge base** and does **incremental search**.

AI Assistants

Real-life

The musician employs an AI tool. However, there are many options - AI tools with different capabilities.

Abstraction

AI Assistant has an **independent** knowledge scope. Different AI tools can have different knowledge scopes.

Model

AI Assistant Agents can search spaces within their knowledge base (which can be outside of the human agent's).

AI Assistants

Real-life

AI Assistants can search and return results **fast**.

Abstraction

AI Assistant can search through a bunch of possible ideas fast. But, this ability is not limitless.

Model

AI Assistant Agent can search through a **subset** of all accessible possibilities (instead of one) and generate ideas fast.

AI Assistants

Real-life

Musicians use the AI tool in an **iterative** manner. The musician can also choose whether or not to accept the AI-generated idea.

Abstraction

Humans and AI influence each other's idea generation process.

Model

For each AI-generated idea, the human agent will only accept it if it is a better idea.

AI Assistants

Real-life

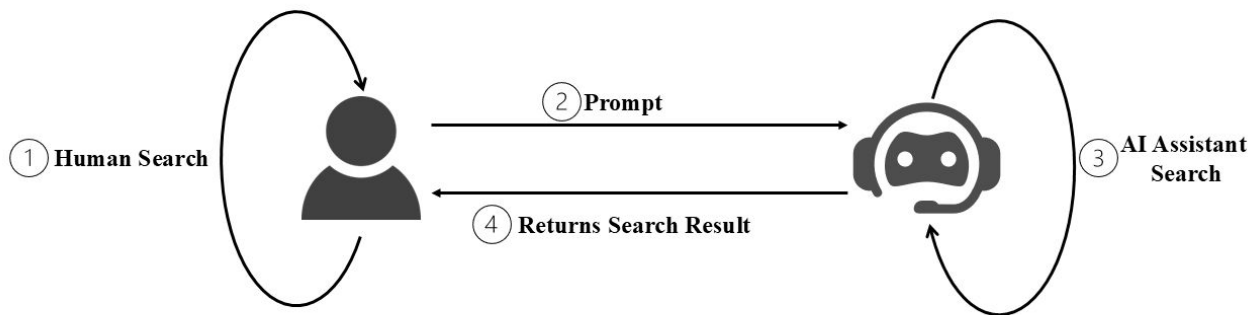
AI's work is affected by how well it understands the problem (e.g. prompt quality, LLM accuracy).

Abstraction

AI assistants *can* be optimizing for the wrong problem.

Model

AI Assistant Agent can evaluate the usefulness based on what the Human Agent wants with **differentiated levels.**



Experiment

<0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11>

{ AI }

{ Human₁ }

{ Human₂ }

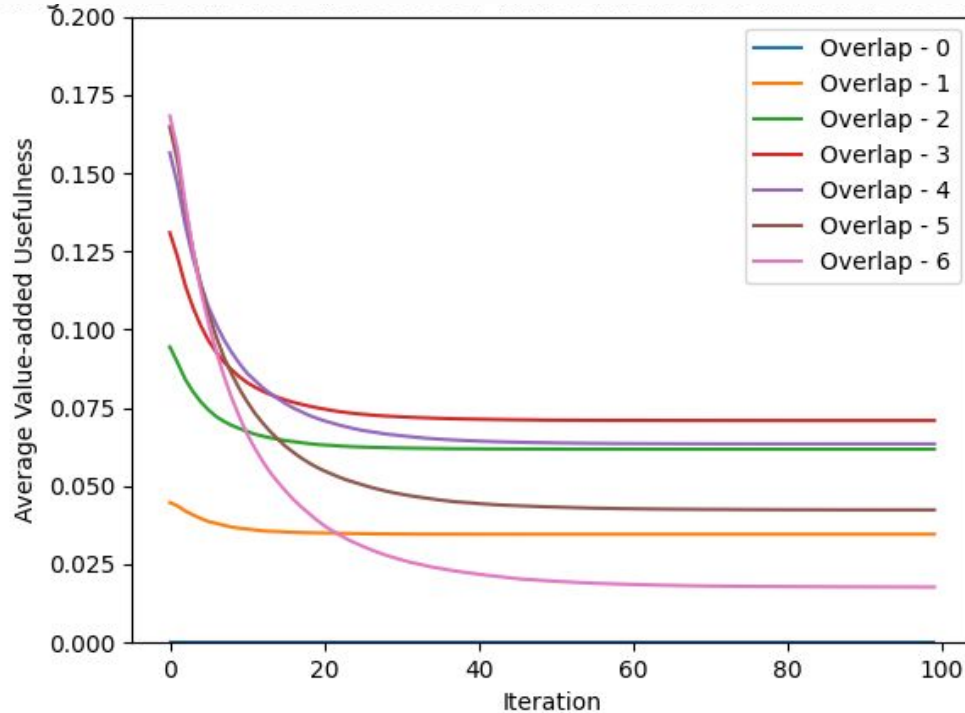
{ Human₃ }

{ Human₄ }

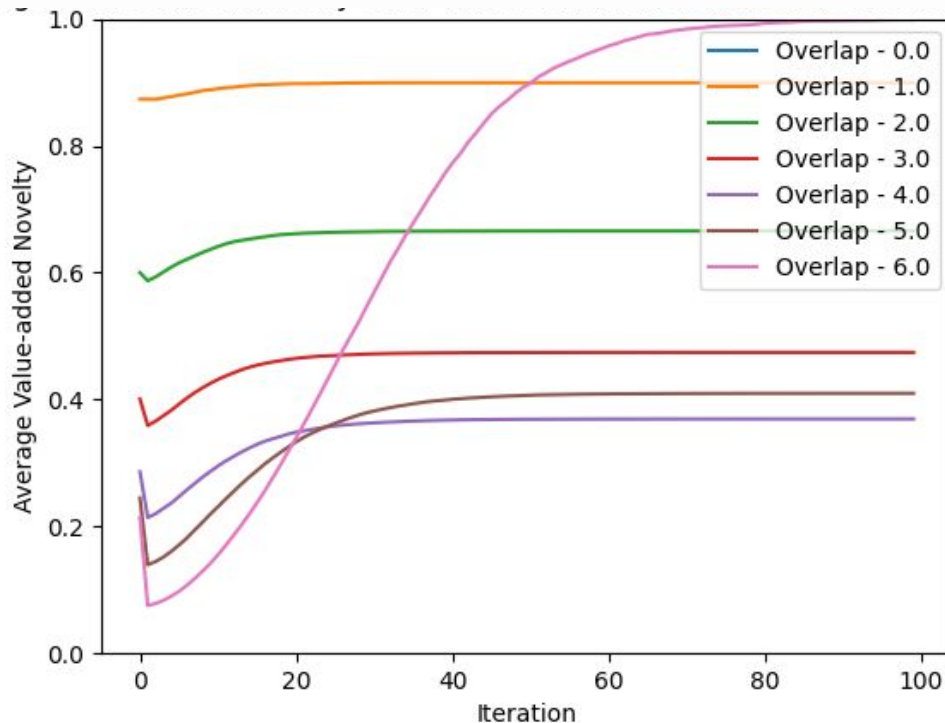
03

Results

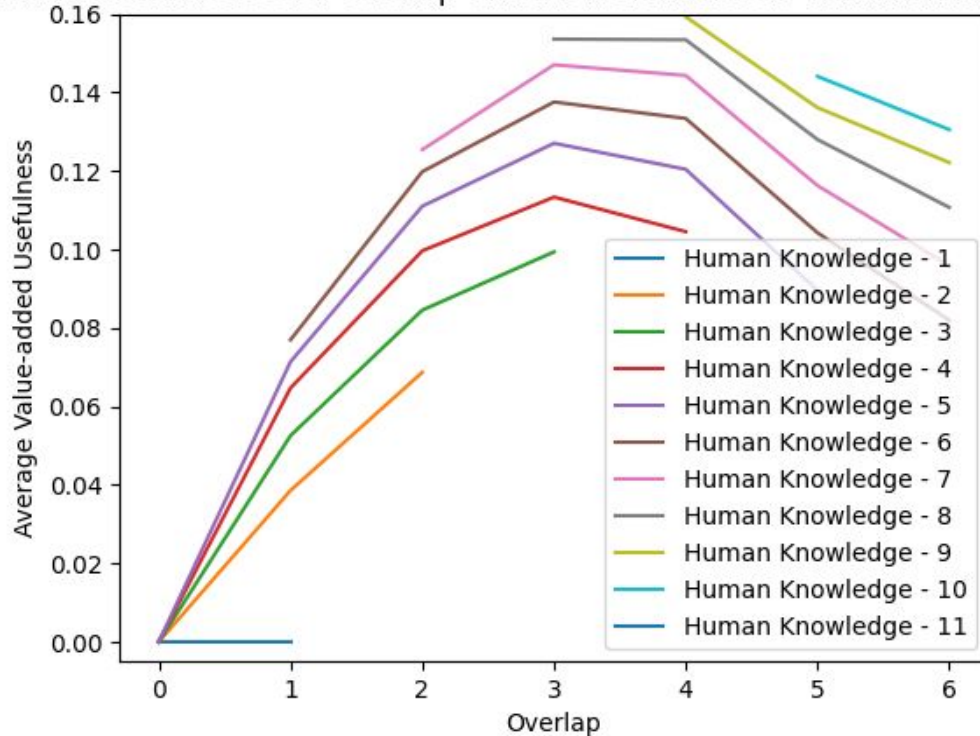
Introduction of AI Assistant Improves Usefulness and Improvement Is The Highest In The Short-term



Introduction of AI Assistants Leads to Lower Novelty and Effect Normalizes with Time



Overlap Has an Inverted U-shape Effect on Value-added Usefulness



Overlap Worsens the Homogenization Effect but Effect Fades with Time

Table 7: Linear Regression Results on Value-added Novelty, Iteration = 5

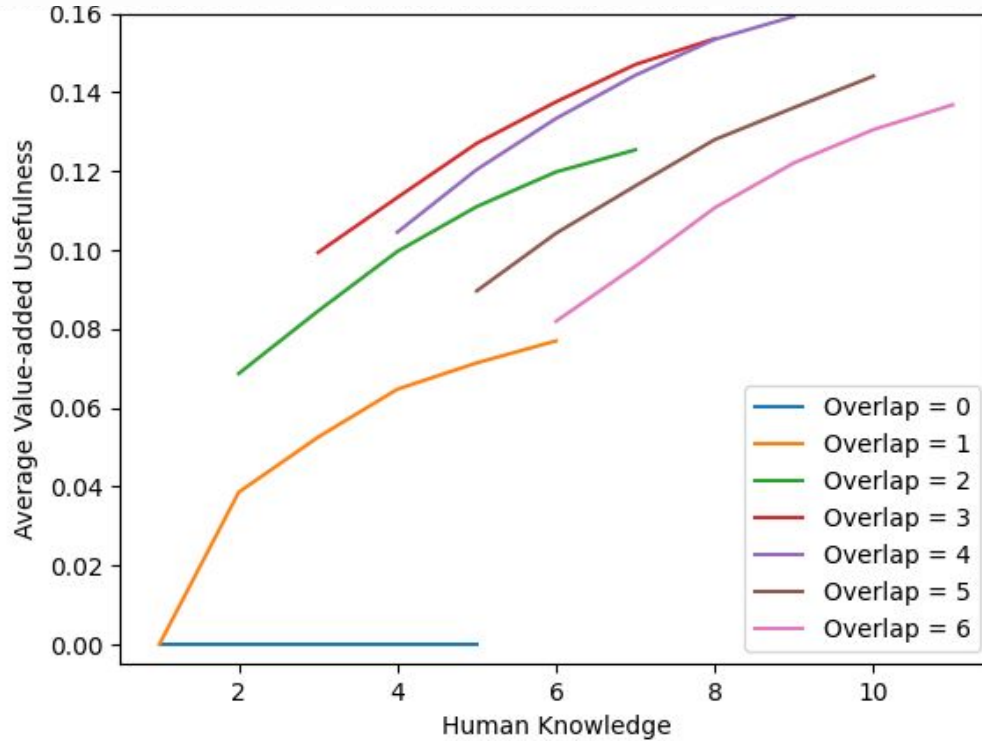
<i>Iteration = 5</i>	<i>K = 0</i>	<i>K = 2</i>	<i>K = 4</i>	<i>K = 6</i>	<i>K = 8</i>	<i>K = 11</i>
Intercept	0.3889*** (0.002)	0.5990*** (0.005)	0.7137*** (0.004)	0.7768*** (0.004)	0.8292*** (0.003)	0.8850*** (0.002)
Overlap	-0.0738*** (0.018)	-0.0455 (0.045)	-0.0386 (0.035)	-0.0719** (0.032)	-0.1076*** (0.028)	-0.1045*** (0.021)
Overlap ²	-0.0462*** (0.008)	0.0200 (0.021)	-0.0485** (0.015)	-0.0719** (0.014)	-0.0494*** (0.014)	-0.0384*** (0.010)
...						

Overlap Worsens the Homogenization Effect but Effect Fades with Time

Table 8: Linear Regression Results on Value-added Novelty, Iteration = 99

<i>Iteration = 99</i>	<i>K = 0</i>	<i>K = 2</i>	<i>K = 4</i>	<i>K = 6</i>	<i>K = 8</i>	<i>K = 11</i>
Intercept	0.3595*** (0.007)	0.6075*** (0.006)	0.7232*** (0.005)	0.7852*** (0.004)	0.8357*** (0.003)	0.8866*** (0.002)
Overlap	0.2169** (0.068)	0.0828 (0.055)	0.0030 (0.042)	-0.0459 (0.032)	-0.0934** (0.029)	-0.0857*** (0.020)
Overlap ²	-0.0505 (0.034)	0.0315 (0.027)	-0.0423** (0.020)	-0.0395** (0.015)	-0.0543*** (0.015)	-0.0412*** (0.010)
...						

Human Knowledge Has a Positive Effect on Value-added Usefulness



Human Knowledge *can* Mitigate Homogenization Effect

Table 7: Linear Regression Results on Value-added Novelty, Iteration = 5

<i>Iteration = 5</i>	<i>K = 0</i>	<i>K = 2</i>	<i>K = 4</i>	<i>K = 6</i>	<i>K = 8</i>	<i>K = 11</i>
Intercept	0.3889*** (0.002)	0.5990*** (0.005)	0.7137*** (0.004)	0.7768*** (0.004)	0.8292*** (0.003)	0.8850*** (0.002)
Average Human Knowledge	-0.1016*** (0.018)	-0.0862* (0.045)	-0.0681* (0.035)	-0.0171 (0.032)	0.0299 (0.028)	0.0427** (0.021)
Overlap X Average Human Knowledge	0.0716*** (0.008)	-0.0091 (0.021)	0.0507** (0.015)	0.0334** (0.014)	0.0456** (0.014)	0.0316** (0.010)
...						

Human Knowledge *can* Mitigate Homogenization Effect

Table 8: Linear Regression Results on Value-added Novelty, Iteration = 99

<i>Iteration = 99</i>	<i>K = 0</i>	<i>K = 2</i>	<i>K = 4</i>	<i>K = 6</i>	<i>K = 8</i>	<i>K = 11</i>
Intercept	0.3595*** (0.007)	0.6075*** (0.006)	0.7232*** (0.005)	0.7852*** (0.004)	0.8357*** (0.003)	0.8866*** (0.002)
Average Human Knowledge	-0.3047*** (0.069)	-0.1635** (0.055)	-0.0775* (0.042)	-0.0215 (0.032)	0.0298 (0.029)	0.0310 (0.020)
Overlap X Average Human Knowledge	0.1341*** (0.034)	0.0032 (0.027)	0.0581** (0.020)	0.0476** (0.015)	0.0560*** (0.015)	0.0375*** (0.010)
...						

04

Discussion & Implications

Introduction of AI Assistants brings Efficiency and Exploratory Effects

Efficiency Effect

- Due to AI Assistant search process
- More prominent in the short-run
- Reduces Bounded Rationality

Positive effect on Usefulness

Negative effect on Novelty, especially short-run

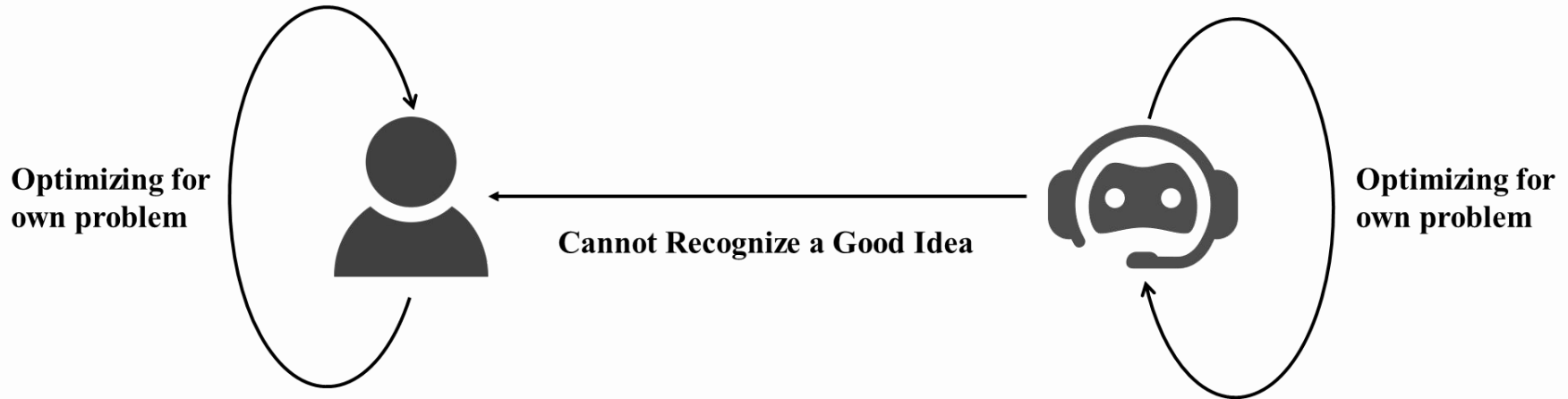
Exploratory Effect

- Due to expansion of joint knowledge base
- More prominent in the long-run
- Reduces Imperfect Information

Positive effect on Usefulness

Ambiguous effect on Novelty

A Coordination Problem Exists between Humans and AI



Accumulating Knowledge That AI Knows Reduces the Coordination Problem

Efficiency Effect

- Due to AI Assistant search process
- More prominent in the short-run
- Reduces Bounded Rationality

Positive effect on
Usefulness

Negative effect on
Novelty, especially
short-run

Exploratory Effect

- Due to expansion of joint knowledge base
- More prominent in the long-run
- Reduces Imperfect Information

Positive effect on
Usefulness

Ambiguous effect
on Novelty

Accumulating Knowledge that AI doesn't know reduces Imperfect Information

<0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11>

{ AI }

{ Human₁ }

{ Human₂ }

Accumulating Knowledge that AI doesn't know *can* mitigate the homogenization effect of AI

<0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11>

{ AI }

{ Human₁ }

{ Human₂ }

Implications



Hiring Decisions

Optimize hiring to ensure goals on usefulness or novelty are met.



Educational Strategies

Encourage learners to accumulate knowledge outside of the AI assistant's scope to enable diversity of ideas.



AI Design Considerations

Focus on mitigating the coordination problem.

05

Limitations

Limitations



AI-specific factors not investigated

AI Assistant Knowledge Base,
Understanding Capabilities,
Computational Constraints



Factors assumed to be exogenous

Acceptance Probability, Human
Learning from AI



Can help AI developers

General vs Specialised AI,
Prompt Engineering, LLM
Development



Can extend our findings

Whether changing human
behavior can mitigate the
homogenization effect

Thank You!

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06

Q&A