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Towards a Work Systems View of Human AI Collaboration in Systems Engineering and Design

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How humans interact with AI in work processes?

Daniel Zender for NYT article March 28, 2023

JT Cestkowski for 27WKOW article Sep 10, 2024

Research Question

- Micro-interactions between humans and AI
  - Human prompting AI (prompt engineering)
  - Allocation of tasks between human and AI
  - AI co-pilot
- Different forms of interaction depending on the problem

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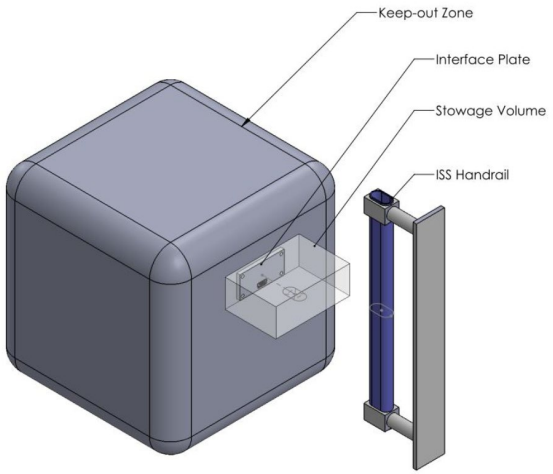
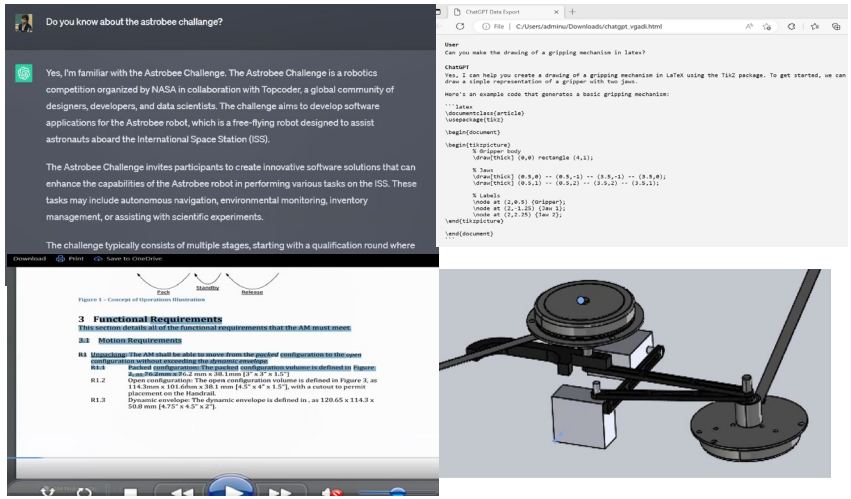
Prior Work

Design Task



Screen Recording



Transcription

USER:

TIME(s)	*ACTIVITIES:*
1.4	User start new prompt.
1.42	Edited prompt and paste generated link, then continue editing prompt.
3.49	Generated response.

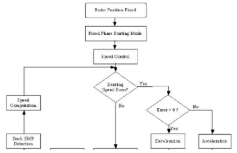
PROMPT: "This PDF is the problem description for the SPAM challenge: https://aipdf.app/7MXeFmi4uz2/xdax.pdf We need to create and submit a solution of our own for this challenge, but I don't know how to do it and I don't have the skills or knowledge to do it, so I need you to do as much as possible to help me. Keep in mind that in this challenge in addition to just looking for the workable solution with the lowest mass, NASA is also looking for new and novel ideas."

CHAT GPT-4:

DESCRIPTION: The user generated link by uploading the problem description file for the challenge

50:14	Then scroll through and focus on the contents of section 3 – "Software Description" in the submission guidelines.
50:16	The user navigated back to the GPT-4 prompt window.
50:17	Then starts entering the new prompt.
50:39	Then navigate back to the submission guidelines document via the web browser.
50:42	The user scrolls through and focuses on the software description flow chart.

The flowchart the user focused on is shown in the figure below:



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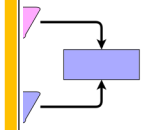
Coding and Analysis

	A	B	C	E	F	H	M
1	Time	Task	Task Keywords	Result	Result Keywords	Type of Task	Description
2	0	User opened GPT-4 and created the following custom insructions: "I am working on a project to produce novel new ideas for engineering problems, but I don't have any background or expertise in engineering."	Setup	N/A	N/A	Setup	GPT-4 would follow the custom instructions whenever providing a response.
3	1.24	User downloaded challenge documents and fed them into aipdf.com	Setup	A PDF was generated that could be read by GPT-4	Generated, PDF	Setup	processed by GPT-4 (https://aipdf.app/7MXeFmi4uz2/xdax.pdf).
4	1.42	User prompted GPT-4 to review the generated PDF and said that a solution needed to be created. User reminded GPT-4 that they do not know how to do this and have no skills or knowledge so the model must do it all. Lastly, user told gpt-4 that NASA is looking for new and novel ideas	Document review	GPT-4 outputed a summary of the SPAM challenge including the description and key requirements. The model then offerend novel ideas for solutions, engineering considerations, and next steps.	Summary, ideation, probing	Information Retrieval	GPT-4 gave a detailed summary and gave some novel ideas for solutions. Above that, GPT-4 went beyond and gave engineering considerations and next steps.
5	6.41	User prompted GTP-4 that for this they did not need to worry about manufacturing, cost, safety, or testing. The user then asked for GPT-4 to design a main mechanical system ideally with novel characters attributes/components/concepts.	Refinement, design, mechanical	GPT-4 outputed a list of concepts for a design. The design was a three-part articulated arm with omni-directional joints and an intelligent control system.	Design, ideation, novelty	Conceptual Design	Note: GPT-4 mispelled the word self. Some of the concepts (AR) were counter to the goal of autonomy
6	8.09	User copied a section of the response pertaining to the concepts and pasted into a blank google doc titled "Running Notes".	Documentation	The model then asked for the user's thoughts and for what it should do next.	Documentation, Probing	Document Drafting	



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Visualizing Micro-interactions

- "Loops"
- Flow of steps in the interaction
- Visually display human vs AI actions
- Differentiate between input/out and processes

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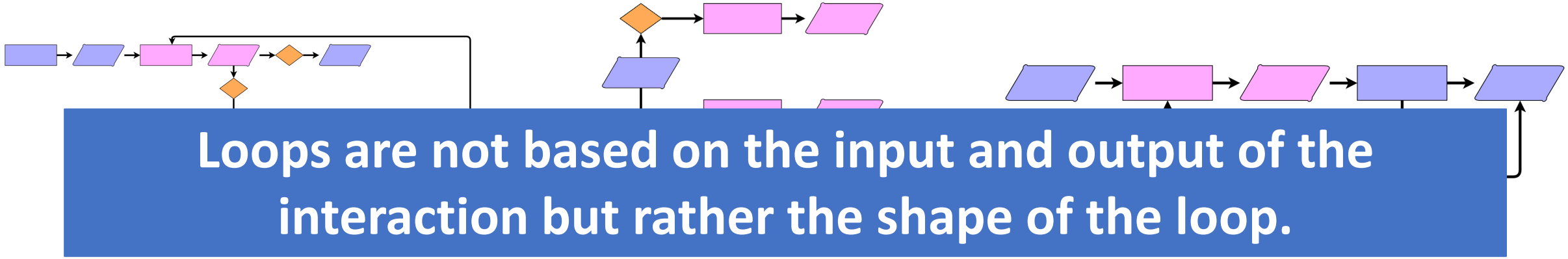
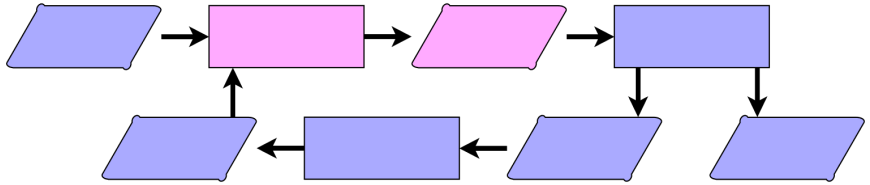
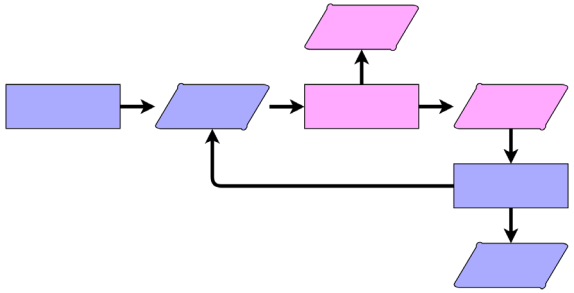
Loops



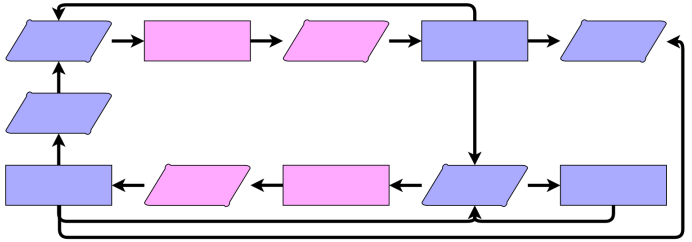
Loops are not based on the input and output of the interaction but rather the shape of the loop.



Task Performance



AI Assessment



AI Assisted Concept Generation

Human

AI

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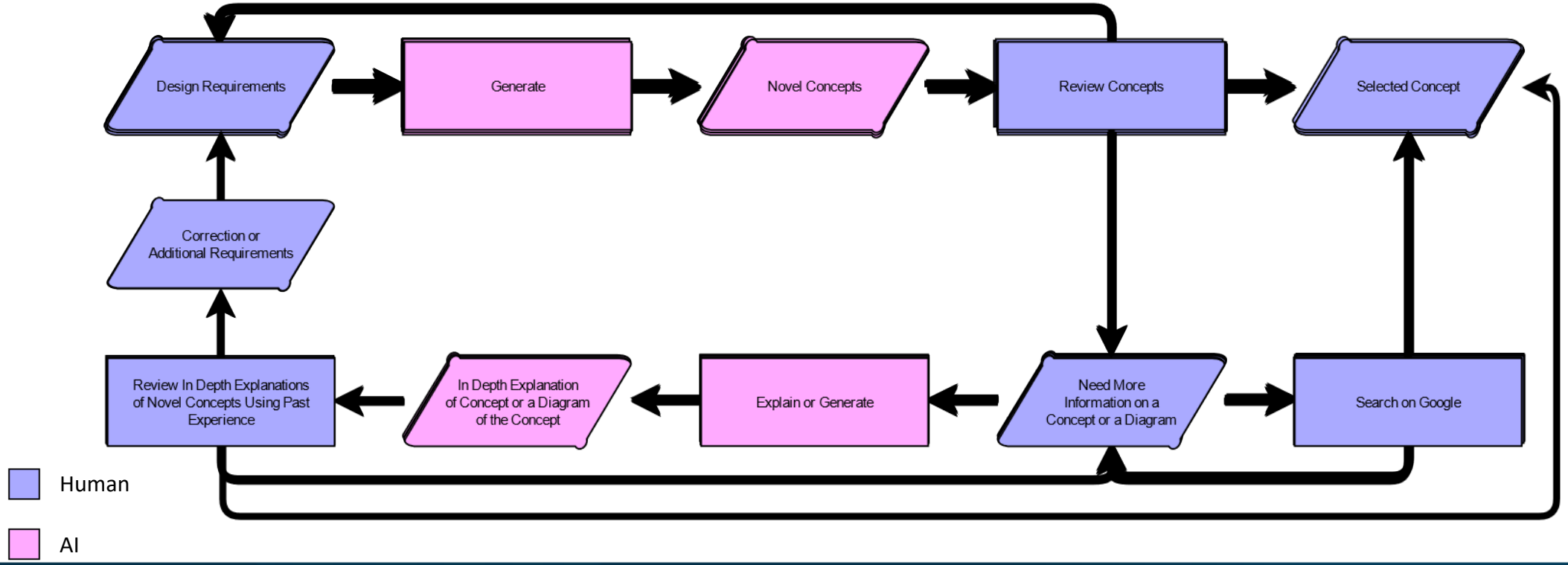
Example Loop: AI Assisted Concept Generation



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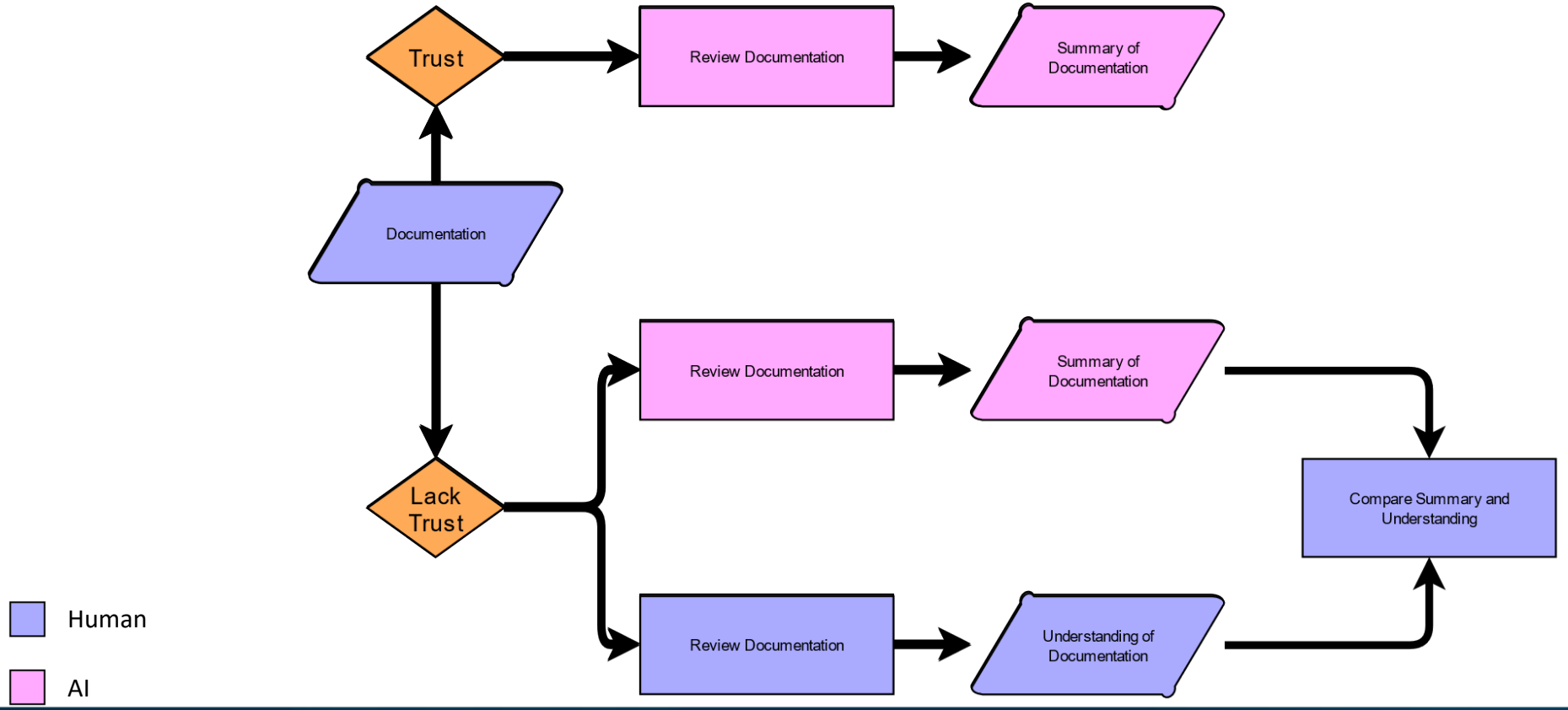
Example Loop: Documentation Review



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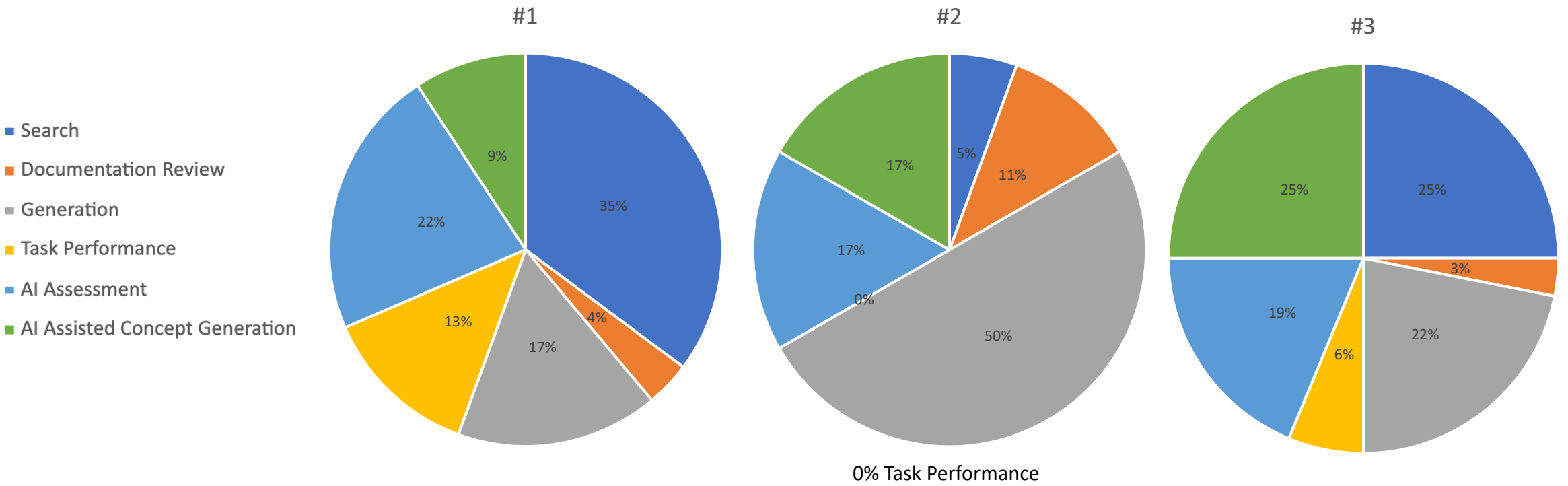
Loop Frequency



0% Task Performance

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Conclusion

- Six different forms of micro-interactions
- Difference in loop frequency

Future Work

- How subject experience affects loop frequency
- Accuracy of AI assisted generated solutions
- Impact of trust

Funding Acknowledgement

This material is based on work partially supported by the U.S. National Science Foundation under Grant No. 2125677.

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QUESTIONS?