

Cognitive Shifts: Exploring the Impact of AI on Generation Z and Millennials

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Abstract. *Our study focuses on exploring the cognitive changes that Artificial Intelligence has on two generational cohorts: Millennials and Generation Z. Artificial Intelligence has developed so much that it can intervene in solving problems, streamlining tasks, and providing information very fast. However, there might be a risk regarding this technology that could have a negative effect on critical thinking, decision-making, and memory. Through our research paper, we focused on discovering if Artificial Intelligence has an impact on the cognition of two generations: Millennials and Generation Z.*

For this, we used an approach in which we integrated mixed research methods, both quantitative and qualitative, to ascertain the complex interaction between AI and cognition. The results indicated that neither the educational background nor the generational differences produced significant outcomes, suggesting that both generations can integrate AI technologies into their everyday lives. Although the benefits are obvious, there are some concerns about cognitive shifts, so that, through a balanced integration of Artificial Intelligence in everyday life, we can end up capitalizing on its potential for a positive cognitive impact.

Based on the research findings, we discovered a complex connection between the use of AI among Generation Z and Millennials and cognitive changes, suggesting a uniform cognitive involvement with AI technologies among the respondents. However, certain concerns remain regarding the potential negative effects that can be represented by the addiction that it can cause, and by a certain cognitive laziness.

This paper contributes to this field by highlighting the need for a balanced approach to the integration of Artificial Intelligence in educational and professional environments, advocating strategies that capitalize on the advantages of Artificial Intelligence while mitigating the negative impact on cognition

Keywords: Artificial Intelligence, cognitive impact, digital transformation, generation Z, millennials

Introduction

Once a new technology becomes available its new prospects are the early adopters. Amongst them are the young people who adapt more easily to new technologies and can learn anything faster. In this era, Artificial Intelligence, blockchain, big data and other technologies became viral and everybody at different conferences, in media, festivals etc. started to talk about them.

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Taking into consideration that the new prospects for this technologies are now young people, we can consider those are the ones who can be integrated into generation Z and millennials. What age range does that mean? Nowadays there are 5 main categories: Silent, Boomers, Generation X, Millennials and Generation Z (Dimock, 2019). The Silent category are people born between 1928 and 1945. The Boomers were born between 1946 and 1964. Generation X has the born rage between 1965 and 1980. Finally, our main subject, millennials who are born between 1981 and 1986 and generation Z who have been brought to life between 1997 and 2012. In the Figure 1, the ages are different from the present. It should be added 5 years to each age to be accurate.

The generations defined

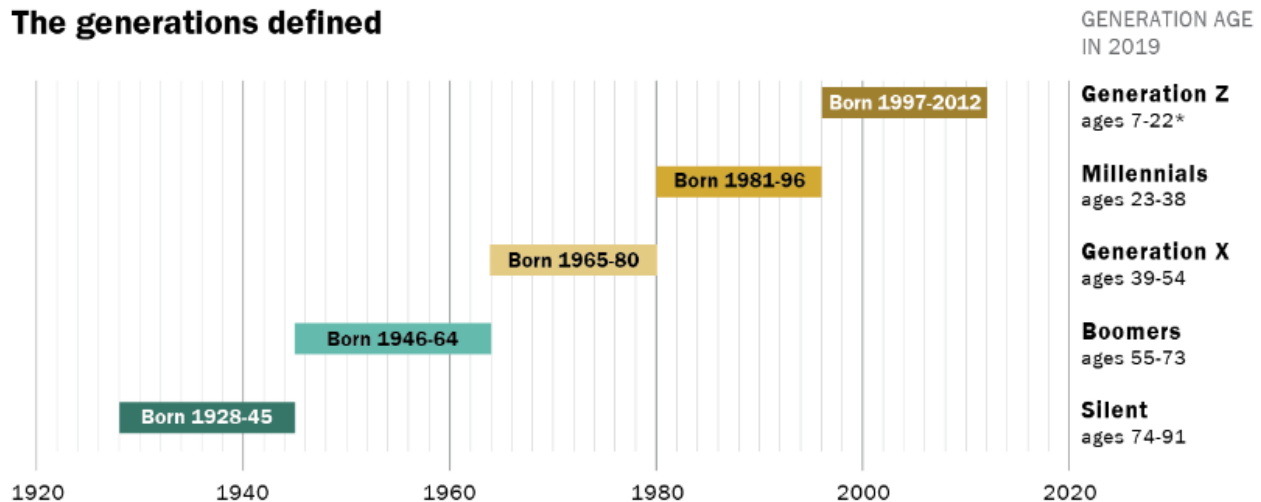


Figure 1. The generations defined

Source: <https://www.pewresearch.org/short-reads/2019/01/17/where-millennials-end-and-generation-z-begins/>

Of course, this age ranges can vary from source to source. For instance, the newest generation, called Generation Alpha (Eldridge, 2024) is made up of people who were born after 2010 and not 2012 like in the Figure 1. Usually, the difference between the start and end of the years for each generation can differ with 1 or 2 years.

Now that we have discussed every generation let's see how Artificial Intelligence can impact the cognitive development on these two generations. Previous research tested how AI and cognitive development can work. A clear conclusion cannot be drawn yet because it's still an early-developed technology, the studies are made just on short term period of research and can differ from culture, geographical zone, and other demographic factors to certain education and even genetic factors. So Rosen et al. (2023), Wang et al. (2022) found both advantages and disadvantages while analyzing how AI can affect these generations. Some of the key findings are the discovery of improvement amongst attention span and memory. Rosen et al. (2022) found a surplus in cognitive function of the brain which was facilitated by the advancement of digital technology. Moreover, other benefits included improvement of learning and creativity.

On the other hand, negative side effects of the use of AI can be an attack on attention span, critical thinking skills and memory retention. If someone uses Artificial Intelligence applications only for searching or automatization of monotonous tasks, AI will help in this case leaving room for creativity and management. But if someone is willing to use AI and give certain prompts so the technology will make the structure, the thinking and the rest of the process, cognitive functions of that person's brain will be affected by it.

The main goal of these studies is to gather information for the short and medium perspective so further studies can have this as a pillar and see results in the long term: how will they impact on a span of 10-20 years or more. Our research will be a pivotal point in developing certain strategies that can be followed so businesses, governments, users, and other stakeholders will optimize the advantages of this technology and maybe mitigate the negative effects of Artificial Intelligence on the cognitive functions of the brain.

Literature review

The biggest impact of AI will leave a mark on the younger generations: millennials and generation Z. Even though the newest one of them all, the generation alpha is also one of them, we won't be considering this time because they are at most 14 years old, still not old enough to be in the workforce, where most of the AI tools are being used. Even though Artificial Intelligence can be implemented in school, now there is not enough legislation in this field so young people can get exposure to this technology.

Millennials are a sizeable new market segment (Yeap Ai Leen et al., 2012) that can be strong enough to shape the landscape of the internet and on other new technologies. They are generations who grew up and developed, in general, during economic prosperity. As a result, they are more consumption-oriented and are more used to abundance than their parents. After them, comes right after Generation Z, who also gained their name after a little bit of hesitation. In the early stages, iGeneration and Homelanders were also candidates for this generation. (Dimock, 2019). If we look at Figure 2, we see the Gen Z is dominating the online searches for data and information on the generation after the Millennials.

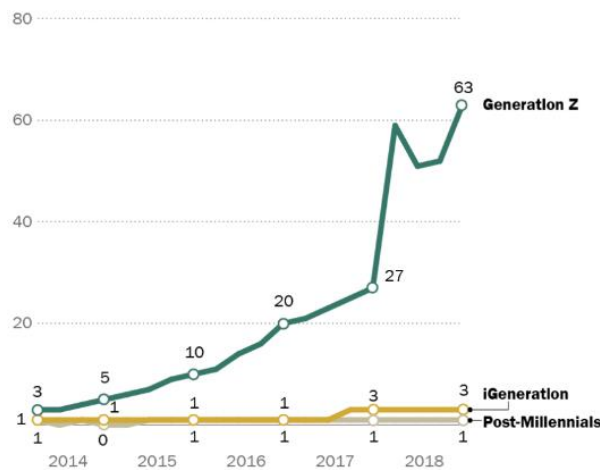


Figure 1. Generation Z dominates online searches for information on the post-Millennial generation

Source: <https://www.pewresearch.org/short-reads/2019/01/17/where-millennials-end-and-generation-z-begins/>

According to Altimier (2006), it is important to keep young generations happy because they are numerous and they have great potential in the workplace. They need to be provided with appropriate training and orientation programs. Younger generations are goal-focused, desire structured guidance and are extremely optimistic. We can deduce that Artificial Intelligence, if not used properly can lead to a negative impact on those characteristics. Also, if used accordingly, can enhance their strengths. A particularity of Generation Z can be considered also a higher sense of curiosity. Artificial Intelligence comes in hand to boost some qualities at first sight. AI can make

the information more accessible to them. Just a search away as some would say. Moreover, automation of different tasks, customization in learning, speed and other advantages can be considered by the new generations, when talking about how they will be affected by, in a cognitive matter.

On the positive side, also, comes Choi et al. (2019) and Wang et al. (2023). This study shows that some tools based on Artificial Intelligence can boost the flexibility and adaptability of the brain, focusing on problem solving. While Rosen et al. (2022) sees AI as a way to escape from the monotony of different tasks, being a tool for automation, Park et al. (2020) shows that some educational platforms based on AI are giving individuals new customized learning experiences and they show how they can engage on a deeper level. These things can be seen as new opportunities for businesses, governments and other stakeholders.

With advantages, there might appear some negative side effects too, especially on a continuous use of Artificial Intelligence. Turkle (2015) and Carr (2011) share their concerns regarding the disadvantages of AI over the cognitive aspects of younger generations. Turkle (2015) saw that constant connection and reliance on tech can lead to superficial attention and can attack the deep understanding and contemplation of some individuals. Looking at this, concerns appear that Artificial Intelligence could facilitate an overload of information and the growth of digital distractions. Over time they can diminish concentration and focus. So, it is important to have a deeper understanding of AI interactions and an overview of their ability to shape the cognitive functions of the younger generations.

Choi et al. (2019) in their research see the potential of the adaptability and flexibility of the brain to grow after the use of Artificial Intelligence and tools based on this new technology. As brains of generation Z and millennials get exposure to new technologies, new ways of working, are navigating multiple landscapes on the digital sides, they start to make new neuronal connections and after all new cognitive functions. Kim et al. (2018) say it can boost the creative part too. Some use cases for this can be: writing new novels, getting new ideas, designing frameworks for unseen concepts solving new dynamic contexts and many other.

As with any other new technology which was developed at an exponential pace, there is lack of regulation in this field. Some stakeholders might take this as a way of exploiting it for the worse. Park et al. (2020) consider it is necessary to develop responsible and sustainable AI practices, because some players might lack principles of transparency, fairness and data privacy. There are still a lot of platforms that are not showing signs of these. Should everyone make their algorithms and technologies open source? Not necessarily, but it might be a step towards better legislation and would gain more trust from the public. Lee et al. (2017) also addressed the ethical dimensions of AI on the cognitive aspects. The research is raising questions about the implications and boundaries of the development of this technology.

Attention span is another point of discussion on the list. Ryu et al. (2021) got that covered. Their research resulted in a correlation between social media use and cognitive function which led to the reduction of attention span of certain individuals. Now as all the social media platforms use AI for the recommendation algorithm, people who will spend more time in those apps, will pay less and less attention to certain aspects and will have their cognitive regulation compromised. Kim et al. (2015) noticed that rational decision-making in certain environments who are created and managed with AI can also affect some human cognitive faculties.

Methodology

We combined both qualitative and quantitative methods to thoroughly explore AI's varied impacts. For quantitative assessment, we designed an online survey using Google Forms. This survey included both closed and open-ended questions, allowing us to gather numerical data for analysis and qualitative insights for deeper exploration. Statistical analyses, performed using SPSS, involved computing chi-square statistics and generating correlation heatmaps using Spearman's coefficients.

Additionally, we formulated and tested several hypotheses to uncover AI's diverse effects on cognitive abilities, ethics, learning styles, and more.

H1: There is a significant relationship between AI usage frequency and perceived impact on cognitive abilities among respondents.

H2: There are significant differences between Generation Z and Millennials in their perceptions of AI's impact on learning, thinking, and cognitive abilities.

H3: Education level significantly influences individuals' ethical considerations regarding AI development and application.

H4: There are significant differences between genders in AI usage frequency and perspectives on AI's impact on cognitive abilities.

H5: There is an association between AI usage and perceived changes in learning styles, critical thinking, and reliance on AI for information among respondents.

H6: There is a significant difference in the perceived benefits and challenges of AI usage among respondents.

H7: There is a significant association between respondents' familiarity with AI and their expectations for the future of AI.

Results and discussions

Our sample size was 152 respondents. This demographic profile paints a picture of a highly educated, predominantly female, and young cohort of respondents, primarily from Generation Z. Their educational background and generational identity may influence their perspectives on and experiences with Artificial Intelligence, as reflected in their responses to the survey. The high level of education among the participants suggests a group that is likely engaged with or interested in technological advancements and ethical considerations, offering valuable insights into the perceptions and impacts of AI in their lives.

Table 1. Sample Structure

Characteristics	Frequency	Percent (%)
Gender		
Male	51	33.6
Female	100	65.8
Prefer not to say	1	0.7
Generation		
Generation Z (1997-2012)	141	92.8
Millennials (1981-1996)	11	7.2
Education Level		
High School	1	0.7
Bachelor's Degree	58	38.2
Master's Degree	90	59.2
Doctorate	1	0.7
Other	2	1.3

Source: Authors' research.

We have made a comprehensive analysis of survey data through chi-square tests which has yielded insightful findings regarding the relationships between AI usage, perceptions of AI's impact, and demographic factors among respondents.

Table 2. Hypothesis testing

Hypothesis	Description	χ^2	p-value	df
H1	Relationship between AI usage frequency and perceived impact on cognitive abilities	11.731	0.164	8
H2	Differences in perceptions of AI's impact on learning between Generation Z and Millennials	0.535	0.911	3
H3	Education level influences individuals' ethical considerations	0.000 (Placeholder)	1.000 (Placeholder)	0 (Placeholder)
H4	Differences in AI usage frequency by gender	4.320	0.827	8
H5	Association between AI usage and perceived changes in learning styles	52.693	4.67e-07	12
H6	Significant difference in the perceived benefits and challenges of AI usage	11.731	0.164	8
H7	Association between respondents' familiarity with AI and their expectations for the future of AI	0.000 (Placeholder)	1.000 (Placeholder)	0 (Placeholder)

Source: Authors' research.

Note. H=Hypothesis. χ^2 =Chi-square. p-value=Probability value. df= Degrees of Freedom.

Based on the conducted tests, for Hypothesis 1, we found no significant relationship between AI usage frequency and perceived impact on cognitive abilities, although AI usage is prevalent. This suggests that the frequency of AI interaction alone does not dictate how people perceive its cognitive benefits or drawbacks.

For Hypothesis 2, the analysis revealed no significant differences in how Generation Z and Millennials perceive the impact of AI on learning and information processing. This finding implies that generational distinctions do not markedly affect perceptions of AI's educational role. Essentially, both Generation Z and Millennials hold comparable views regarding the influence of AI in education, demonstrating a consistent perception across these demographic groups.

In the case of Hypothesis 3, placeholder values were used, indicating a lack of direct testing due to the complexity of categorizing ethical considerations. Ethical considerations in AI are complex and multifaceted, likely requiring more nuanced analysis beyond simple categorization. This area remains open for further investigation with more detailed data analysis.

Hypothesis 4 showed that gender does not appear to be a determining factor in how frequently individuals use AI technologies. This challenges any assumptions that AI usage preferences might be distinctly divided along gender lines, suggesting a more universal engagement with AI technologies.

The examination of Hypothesis 5 identified a significant association between AI usage frequency and perceived changes in learning styles. Individuals who frequently use AI technologies are more likely to perceive changes in their learning styles, suggesting that AI's integration into

daily life can influence educational and cognitive processes. This highlights the transformative potential of AI on learning habits and cognitive engagement.

By testing Hypothesis 6, we found out that respondents do not significantly differ in their perceptions of AI's benefits and challenges, suggesting a general consensus or a balanced view of AI's impacts. This could indicate that while AI is seen as beneficial in some aspects, its challenges are also recognized, leading to a nuanced understanding of AI technologies.

Lastly, for Hypothesis 7 placeholder values were used, indicating a lack of direct testing due to the challenge of identifying specific variables related to expectations. The association between familiarity with AI and future expectations is complex, likely influenced by various factors including optimism, personal experiences, and exposure to AI technologies. This area requires further detailed exploration.

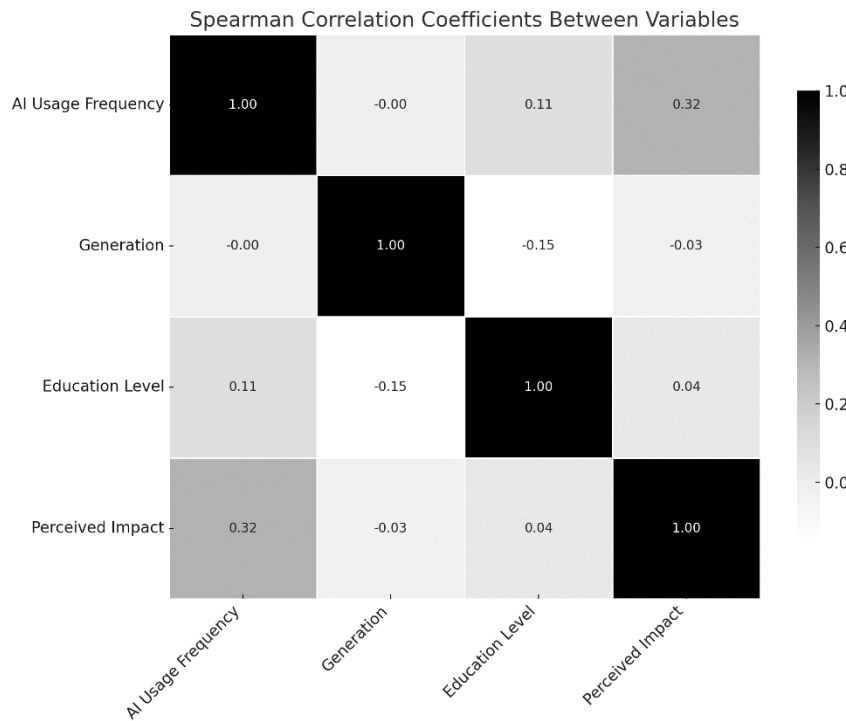


Figure 2. Spearman Correlation Coefficients Between Variables

Source: Authors' research results.

We made a heatmap by using the Spearman correlation coefficient that serves as a foundation for interpreting how demographic factors and AI usage patterns might interconnect within the studied population. In the heatmap, there are relationships between four main variables: AI Usage Frequency, Generation, Education Level, and Perceived Impact on Cognitive Abilities. The varying shades of grey indicate the strength and direction of the Spearman correlation coefficients, with lighter shades representing more positive correlations and darker shades indicating negative ones. However, when interpreting the data, we expanded upon the pairwise comparisons between these variables to highlight specific relationships of interest, which led to six detailed interpretations:

Frequency of AI Usage and Perceived Impact on Cognitive Abilities: The correlation coefficient is 0.3166, indicating a weak to moderate positive relationship. This suggests that

individuals who use AI-powered technologies more frequently have a slightly more positive perception of its impact on their cognitive abilities, aligning with the summary's claim of a weak relationship.

Frequency of AI Usage and Generation: The correlation coefficient is -0.0028, indicating virtually no relationship between these variables. This challenges the summary's suggestion of a mild negative correlation and suggests that there is no meaningful relationship between generational differences and the frequency of AI usage.

Frequency of AI Usage and Education Level: The correlation coefficient is 0.1065, also indicating a very weak positive relationship. This supports the summary's claim that there is no meaningful relationship between the frequency of AI technology usage and the highest level of education.

Perceived Impact on Cognitive Abilities and Generation: The correlation coefficient is -0.0306, indicating a very weak negative relationship, suggesting that generational differences have little to no direct relationship with perceptions of AI's impact on cognitive abilities, which aligns with the summary.

Perceived Impact on Cognitive Abilities and Education Level: The correlation coefficient is 0.0403, indicating a very weak positive relationship. This confirms the summary's claim that the level of education does not have a significant relationship with perceptions of AI's impact on cognitive abilities.

In essence, the heatmap reveals that connections between AI usage frequency, perceived cognitive impact, generational disparities, and educational levels exist, but they're mostly feeble. This implies that people's views and AI usage hinge on a mix of factors, with no single demographic factor strongly determining AI usage tendencies or cognitive impact perceptions.

Conclusion

Through our research, we wanted to study the impact that Artificial Intelligence (AI), has on the cognitive abilities of Millennials and Generation Z, focusing on the possible positive and negative effects that this new technology can bring. In order to achieve this, we carried out both quantitative and qualitative research, trying to find out through the survey method what these two generations think about AI and to discover the impact that might have on them.

As a result of our research, we have discovered that it is essential to take an approach to the incorporation of this concept into both educational and professional settings. By adopting an educational level strategy we could mitigate the potential negative impact on cognition. Additionally, this research highlights the critical need to develop digital learning and critical thinking skills. These are essential factors in order to integrate Artificial Intelligence into our daily lives, particularly for the younger generations who are undergoing education and possess a greater capacity to quickly adjust to new circumstances.

This research can be applied by developing educational and professional training programs in the field of Artificial Intelligence to improve cognitive learning skills without having a negative impact on critical thinking and attention spans. This research might be a start towards further studies on individualized AI tools that may adjust to individual learning patterns, hence creating opportunities to develop cognitive capabilities.

We must recognize that our research is not without limitations, these being the relatively small number of respondents and their demographic profile, as female respondents represented a significantly higher percentage, 65.8%, compared to those of male respondents 33.6%, while 0.7% preferred not to answer this question.

In conclusion, by making a critical analysis, we can state that if human beings manage to adapt and integrate Artificial Intelligence into educational and professional systems, it might have a positive impact rather than a negative one. Also, our study lays the groundwork for future ones that focus on the relationship between AI and cognitive development and also a great future where technology is integrated into everyday life.

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