

Hands-On AI and Robotics for Older Adults: Exploring Cognitive Engagement, Healthy Aging, and Technology Adaptation through EFMIGO

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Abstract

The rapid development of artificial intelligence and robotics has raised new questions as to how older people interact with new technology and whether carrying out practical technological activities can help promote cognitive engagement and healthy aging. This study examined older adults' experiences with AI and robotics via EFMIGO, a computer-free coding and robotics program which enables participants to construct physical robots and programme their movements by using barcode command cards. Seven older people, aged between 70 and 80, took part in qualitative interviews covering their daily routines, memory, concentration, problem-solving, well-being and adaptation to technology. The results showed varied outcomes in relation to memory, since three participants said they had a clear sense of improvement while the others talked of increased memory practice or stayed uncertain. The most consistent finding was with regard to cognitive engagement, as the majority of the participants mentioned having better concentration and adopting more systematic methods when solving problems. The participants also linked the activities to staying mentally active, becoming more aware of their own health, and feeling more confident. Most of them became more at ease with unfamiliar technology as a result of repeated practice, although the amount of support each person needed varied. The overall conclusion is that hands-on activities involving AI and robotics might offer valuable opportunities for older adults to remain mentally engaged and to build up greater confidence in using new technology.

Keywords: older adults, elders, artificial intelligence, robotics, cognitive engagement, healthy aging, technology adaptation, EFMIGO

Introduction

The 4th Industrial Revolution (the new digital society) represents the new world that society is adapting to. This new society revolves around AI, robotics, technology, and coding. Although these developments are mentioned and beneficial to the younger generation, they also raise questions about whether the older generation is adapting to this new status quo (Schwab 2016). The new rising question made me realize how the same device could be indispensable for one individual but alienating to another. This study examines whether hands-on AI and robotics activities can help prevent elders from experiencing cognitive decline. The EFMIGO devices and other technological devices enabled them to actively use their brains during their free time by using both hands, maintaining concentration, and remembering instructions.

The relationship between older adults and technology has changed drastically as technology itself has developed. Earlier forms of the digital divide were dependent on whether individuals had access to different forms of technology like computers or smartphones (Neves and Mead 2021). However, the rapid development of AI and robotic devices has initiated a different challenge. Exposure or access to a device does not automatically enable an individual to become accustomed to or comfortable interacting with it

(Neves and Mead 2021). As the status quo treats technology as an integral part of our daily lives, older adults are being introduced to areas where they are unfamiliar, even if they have already experienced using digital devices.

The new digital divide is significant for more than technological adaptation alone. Limitations of older adults raise questions about how they can participate in activities that demand them to think, remember, and solve complex sequences. Rather than viewing new technology as an area of technology seniors must learn, using technology as a tool to encourage overall cognitive engagement will contribute to their well-aging and memory (World Health Organization 2020). Hands-on robotics and coding reveal a clear distinction between participants simply watching a screen or receiving information. Allowing seniors to physically interact with the materials and respond accordingly creates an opportunity to examine the relationship between learning new technology and remaining mentally active.

EFMIGO is a nonprofit educational organization that I helped to set up and run with the aim of making coding and robotics education available to students and other participants who might not otherwise have access to computers. My responsibilities involve creating EFMIGO's computer-free coding curriculum, preparing and organizing the robotics kits, teaching participants how to build and program robots, and assisting with the distribution of the kits so that the participants can carry on practicing on their own outside of the structured lessons.



Unlike conventional robotics programs, which require the use of a laptop or tablet, EFMIGO features a computer-free method of programming. The participants begin by building up physical robots using the reusable EFMIGO robotics kits. As the pictures illustrate, each kit includes organized sets of structural beams, connectors, gears, wheels, axles, fasteners, mechanical components, electronic parts, and all the other parts needed to construct various robotic designs. The participants then program the robots by arranging and scanning barcode command cards, each barcode standing for a particular movement or instruction. This enables the participants to work on problem-solving and hands-on construction without having to write code on a computer.

Participants are also given access to an EFMIGO robotics kit that they can use outside of formal lessons. Because participants can assemble the components in different designs on multiple occasions and give the robots different sequences of commands, the kits are intended for continuous use rather than a single activity. The fact that participants can engage in this kind of repeated interaction enables them to stay mentally involved as they continue to practice the skills taught during the EFMIGO sessions.

It is important to note that EFMIGO was a

nonprofit organization that was both already established and in operation prior to my involvement with Pioneer Academics and before the Pioneer research project was developed. Since this was the case, the organization, its robotics kits, and its approach of programming using barcodes without the use of computers had not been created specifically for the purpose of this study. The Pioneer research takes an existing educational program and examines its possible applications and effects within a more systematic research context.



The computer-free design of EFMIGO is essential to this study because participants do not need previous programming experience to interact with the devices and activities. Instead, coding becomes a physical process in which participants can use their creativity and troubleshoot sequences hands-on. Because the kits can also be used at home, participants have the opportunity to return to valuable tasks through repeated practice.

Through these activities, this research explores several questions about older adults and technology. By examining how technology fits

into seniors' daily routines and how AI and robotic activities relate to memory and cognitive ability, we can see how participants associate these experiences with healthy aging. The study also considers how elders respond when they encounter unfamiliar technology and whether it influences their confidence. These questions are aimed not only at whether older adults can adapt to a rapidly changing technological society, but also what benefits they may gain from actively participating.

Pseudonym	Age	Gender
Claire	72	Female
Julie	76	Female
Chloe	75	Female
Paris	73	Female
Emily	74	Female
Kyle	77	Male
Andrew	80	Male

Literature Review/Research

Questions/Hypotheses

Researchers have begun examining whether AI and robotic devices can play a major role in supporting elders, as technology is essential in the 4th industrial revolution (Schwab 2016). Previous research has approached this question through humanoid robots, tablet-based cognitive programs, VR, and robot-assisted cognitive training (Velloso et al. 2025). EFMIGO and these devices share an important characteristic where older adults are required to actively interact with unfamiliar technology. Together, these studies provide a strong basis for examining whether hands-on technological experience can influence

memory, problem-solving, healthy aging, and elders' adaptation to new technology.

Exposure to Technology for Older Adults

The big issue surrounding new technology is whether elders are actually comfortable using devices they have not previously encountered. Park et al. (2021) examined older adults participating in a cognitive training program using SIL-Bot, a humanoid robot (Park, Jung, and Lee 2021). The researchers noticed that technologies such as robots may be unfamiliar to older adults, and gradually introducing new technology to elders could help the adaptation process (Park, Jung, and Lee 2021). The study also suggested that robot-assisted cognitive training has more potential than other new technological devices and reduces aspects of the digital divide among older adults (Park, Jung, and Lee 2021).

In this study, technology did not necessarily mean that an individual would be equally comfortable with other types of technology. An older adult could regularly use a smartphone or computer but have no previous experience interacting with a robot or understand how programming works (Vaportzis, Clausen, and Gow 2017). Previous research therefore raises questions about how elders would respond when introduced to newer and other forms of technology.

Research Question 1: How do elders typically spend their day?

Hypothesis Based on Previous Research:

Older adults, in general, have limited exposure to

technology (AI and robotic devices). When they start using them, hands-on experience and repeated exposure may help them become more confident (Vaportzis, Clausen, and Gow 2017).

Memory and Technology-Based Cognitive Training

Memory has been one of the most frequently studied outcomes of technology-based cognitive training (Velloso et al. 2025). Park et al. (2021) conducted a randomized controlled trial using SIL-Bot as part of a six-week cognitive training program (Park, Jung, and Lee 2021). Participants would complete twelve training sessions (Park, Jung, and Lee 2021). The robot-assisted group demonstrated clear improvements in overall cognitive function and memory (Park, Jung, and Lee 2021). These findings strongly suggest that repeated participation in structured robotic activities buttresses their cognitive skills.

More recently, Kim et al. (2025) examined a ten-week tablet-based cognitive training program for older adults experiencing cognitive decline (Kim et al. 2025). Unlike studies relying on participants' responses and perceptions, the study used standardized cognitive assessments as well as EEG measurements (Kim et al. 2025). Participants would go through several memory tasks, including pattern-recognition and delayed matching (Kim et al. 2025). However, the experts did not discover significant improvements in attention, suggesting that cognitive training may affect particular cognitive abilities rather than producing an overall improvement of all areas

(Kim et al. 2025).

Both studies involved repeated cognitive activities over weeks. Although EFMIGO uses physical robots and barcodes rather than a tablet or humanoid robot, participants similarly provide feedback, as the articles stated as well. The experts' findings therefore led me to examine whether older adults would also perceive changes in memory after repeated interaction through EFMIGO devices.

Research Question 2: How do AI and robotic devices affect memory in older adults?

Hypothesis: Repeated AI and robotic activities may support memory by requiring older adults to repeatedly recall instructions and remember the order of tasks. Continued practice may therefore be associated with perceived improvements in memory (Kim et al. 2025).

Cognitive Ability and Problem-Solving

Studies suggest that cognitive training may influence other aspects of brain function beyond memory (Kim et al. 2015). Kim et al. (2015) examined the effects of traditional and robot-assisted cognitive training on healthy adults aged 60 and older (Kim et al. 2015). Participants underwent twelve weeks of cognitive training, while a control group received no training (Kim et al. 2015). Brain imaging before and after revealed that the cognitive training groups experienced less cortical thinning, the gradual reduction in the thickness of the brain's outer gray-matter layer that commonly occurs with

aging, compared with the control group (Kim et al. 2015). The researchers concluded that cognitive training may help reduce age-related structural changes in the brain (Kim et al. 2015).

However, an important finding from this study revealed that robot-assisted training was not consistently superior (Kim et al. 2015). When the traditional and robot-assisted groups were directly compared, the robot-assisted groups did not perform better on a neuropsychological measure (Kim et al. 2015). These brain scan results suggest that cognitive and physical engagement may be more important than simply using a robot. From this study, it is presumed that technology alone should not be assumed to automatically improve cognitive abilities.

Research combining cognitive and physical activity provides another perspective. Kwan et al. (2021) examined VR motor-cognitive training among elders with cognitive frailty (Kwan et al. 2021). Participants completed VR tasks every day after completing physical exercise. After eight weeks, the VR group demonstrated greater improvement in cognitive function than the comparison group (Kwan et al. 2021).

As EFMIGO also requires participants to physically interact with materials and think through tasks, this research heavily supports this paper.

Research Question 3: How do AI and robotic devices affect cognitive ability, problem-solving, and thinking skills?

Hypothesis: Interactive AI and robotic activities that require active participation will encourage cognitive engagement. Activities that require participants to think through a problem, recognize mistakes, and try again may particularly support concentration and problem-solving (Kwan et al. 2021).

Well-being and Healthy Aging

The possible benefits of AI and robotic devices are not limited to cognitive performance. Researchers have also examined overall well-being. Noh and Shim (2023) conducted a meta-analysis of robot interventions among elders experiencing cognitive decline (Noh and Shim 2023). The results showed that robot interventions significantly reduced anxiety and agitation (Noh and Shim 2023). However, the analysis did not find major overall effects on cognitive function or quality of life (Noh and Shim 2023).

These findings suggest that AI and robotic activities should not be automatically treated as means of preventing cognitive decline (Noh and Shim 2023). Instead, its benefits differ and appear in different forms for different individuals (Noh and Shim 2023). For some elders, interacting with robotics may influence motivation or psychological well-being even when perceived cognitive improvement is unclear (Noh and Shim 2023).

This distinction becomes relevant when considering well-aging. Healthy aging involves more than just memory and cognitive

improvement alone (World Health Organization 2020). Remaining mentally engaged and willing to learn unfamiliar activities influence elders' overall well-being (World Health Organization 2020). The previous literature thus suggests that effects of AI and robotic interventions should be considered across multiple aspects rather than just one cognitive outcome.

Research Question 4: How do AI and robotic devices contribute to healthy aging in older adults?

It is possible that positive experiences involving AI and robotic activities could help promote healthy aging by prompting older people to stay mentally active and more conscious of their general well-being. Yet the effects might vary from person to person and do not always lead to clear improvements in cognitive function (Noh and Shim 2023).

Technology Adaptation

The final issue concerning the literature was whether older adults are willing to and able to adapt to unfamiliar technology. The Technology Acceptance Model explains that elders' willingness to adapt to technology is strongly dependent on whether the technology looks easy to use (Davis 1989).

Experts' opinions involving robots support this concern. Noh and Shim (2023) noted that previous studies have found both negative and positive perceptions of assistive robots among older adults (Noh and Shim 2023). Some elders

expressed negative attitudes towards robots, while others responded positively and found their functions to be useful (Noh and Shim 2023). Park et al. (2021) also observed that robots and smart devices may initially seem confusing and unfamiliar to older adults and suggested that gradual exposure could help the participants adapt (Park, Jung, and Lee 2021). Their study further proposed that robot-assisted cognitive training could contribute to greater technology acceptance. (Park et al. 2021)

These findings suggest that adaptation is not necessarily immediate, but elders may need time to understand and feel confident about the device (Chen et al. 2020). Repeated practice may be especially crucial as it allows unfamiliar activity to become more recognizable, allowing seniors to become familiar with the devices (Chen et al. 2020). At the same time, individual differences prove that some older adults may adapt more quickly than others to unfamiliar AI and robotic devices (Chen et al. 2020).

Research Question 5: How do elders adapt to the new society of the 4th Industrial Revolution?

Hypothesis: Elders may struggle with unfamiliar technology initially, but repeated practice and direct exposure can encourage them to become more comfortable and confident when using AI and robotic devices (Chen et al. 2020).

Methods

Seven older adults between the ages of 70 and 80 participated in the interviews, including 2 men

and 5 women. Each interview lasted about 10 minutes and was conducted through a single Zoom link while participants were enjoying their time at the local senior welfare center. Before I started each interview, I explained the purpose of the interview and received verbal permission from each participant to use their answers in a research paper. The conversations I had with the seniors were very meaningful as the participants gave thoughtful answers. Each participant was very open about the activities that they did back home and their story.

The participants had previously taken part in EFMIGO activities. In those activities, they put together physical robots, arranged barcode programming cards in sequence, used the cards to control the robots, watched the results, and made any necessary corrections. The activities asked the participants to remember instructions and organize commands. Participants could also continue practicing with the robotics materials outside the structured lessons.

Once the interviews were completed, the Korean answers were translated into English and organized according to each research question. I compared participants' responses to identify recurring patterns and differences between the participants. I divided the responses into categories such as reported improvement and uncertainty.

Research Question 1: How do older adults typically spend their day, and what exposure do they have to technology?

The initial research question looked at people's daily routines and their prior experience with technology, and the results indicated that the participants were more active and had greater exposure to technology than the original hypothesis had predicted.

Daily Activity

Many participants maintained routines involving exercise, social activities, classes, religious participation, music, or other hobbies.

Claire described a routine combining religious, social, and physical activities:

"I go to Mass at church. I then head over to the senior welfare center to eat lunch, attend many different classes, and exercise. In the evening, I take a walk with many of the women from my neighborhood. After I return home, I shower and go to bed."

The fact that she responded in that way shows that the welfare center was only one element of her routine which also included attending church, taking classes, doing exercise, walking and interacting with the other members of her neighbourhood.

Emily described an even more physically active routine:

"I try to stay physically active throughout the day. I joined a table tennis club and exercise with other members. I also try to walk more than 10,000 steps each day, often at Hakdong Park."

She also mentioned the exercises which she did

before getting out of bed, her habit of attending church regularly, and her weekly participation in a line-dancing class. This response shows the reason why the participants should not be automatically regarded as physically or socially inactive.

Kyle likewise described multiple activities:

"I participate in yoga classes twice a week in the evening and attend a theater-related activity about once every two weeks. I also exercise, take part in community activities, prepare meals, clean, and organize my home. I sometimes participate in music activities, including a saxophone ensemble."

Exposure to technology

At first, it was thought that older people as a rule would have had only limited experience of technology; but the interviews indicated that most of the participants were already familiar with common digital technology.

Claire stated:

"I mainly use my smartphone and AI services such as Gemini."

Julie made use of both ChatGPT and Gemini, and Emily as well said that she frequently used both Gemini and ChatGPT.

Kyle's response was particularly important because his exposure extended beyond conventional smartphones and generative AI:

"I have used AI services such as ChatGPT and Clova. I have also interacted with Hyodol, an AI

companion robot available through the senior welfare center."

What Kyle has experienced shows that some of the participants had interacted with AI prior to taking part in the physical EFMIGO robotics.

That didn't mean that people who were familiar with everyday technology were also familiar with physical robotics and programming. Kyle later made it clear:

"I had some experience with ChatGPT, Clova, and the Hyodol companion robot. However, I had less experience building physical robots and programming them with barcode cards."

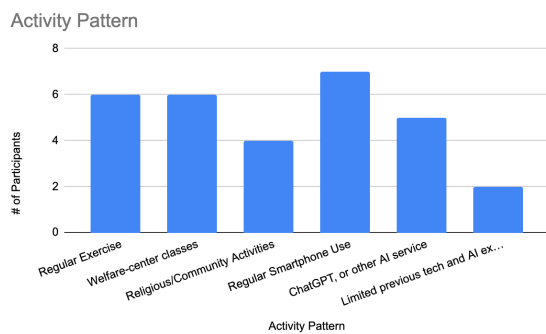
The same pattern was observed among the other participants. Although Claire was already familiar with smartphones and Gemini she said:

"I was not very familiar with assembling robots or programming them through physical barcode cards."

Andrew represented the participant with the least prior technological familiarity:

"I was not very familiar with AI or robotics. I only used basic smartphone functions and occasionally used Gemini or ChatGPT. I had no previous experience assembling robots or programming them with barcode cards."

Result



The results therefore partially supported the hypothesis.

The participants were not as technologically ignorant as had been initially predicted since most of them already had experience using smartphones and a number of them had used generative AI or AI-equipped devices. Yet almost all of them still had very little experience in physically putting together robots and in programming them using barcode cards.

The real distinction was therefore not merely one between having technology and having no technology, but rather it lay in being familiar with common digital technology and having experience with unfamiliar forms of hands-on robotics.

Research Question 2: How do AI and robotic devices affect memory in adults?

Hypothesis Based on Earlier Research

Research proves that AI and robotic activities improve memory performance by allowing elders to repeat mental tasks through these devices (Kim et al. 2025).

The results in response to the second research

question were more mixed than those for the other questions.

Three participants (Julie, Chloe, and Paris) clearly stated that they perceived memory improvement. Emily and Kyle described increased memory awareness or repeated memory practice but did not describe the same degree of clear everyday improvement. Claire and Andrew remained uncertain about whether their memory had actually changed.

Perceived Improvement through continued practice

Julie directly connected continued participation with concentration and memory:

"During the EFMIGO robotics activities, I felt that my brain became more alert and active. After continuing the activities, I noticed that my concentration and memory gradually improved."

Julie also described what the programming activity required:

"The process of arranging programming cards in sequence and checking the robot's movement helped me think carefully. It required me to organize my thoughts, follow each step, and identify what needed to be changed."

These two responses are important when considered together. Julie did not merely say that she thought her memory had improved; she also explained an activity which involved her having to observe and troubleshoot accordingly.

Julie separately reported improvement in everyday

remembering:

"I feel that my memory has improved significantly compared with before. Past events and important moments come to mind more clearly, and I can better remember places, objects, and people I have encountered."

Her responses therefore provided one of the clearest examples of a participant perceiving memory improvement.

Remembered Appointments More Often

Paris also connected the experience with memory outside the immediate robotics activity:

"I have become better at remembering meeting times and appointments. I also feel that I can remember what I learned during lessons for a longer period than before."

She further explained:

"I feel that my ability to remember instructions and recently learned information has improved. Activities involving sequences and repeated practice have helped me retain information for longer."

Paris's answers are important because she highlights two different types of memory through practical examples. Such as appointments and retaining information learned in lessons.

She also connected memory with learning musical instruments:

"When learning the cello and flute, I must remember finger positions. In robotics activities,

I must assemble parts, remember instructions, and arrange commands in the proper order."

This indicates that Paris saw the memory requirements as being similar in the case of robotics and in other learning activities.

Remembering Instructions

Chloe also clearly perceived improvement:

"I feel that my memory has improved considerably. Repeatedly remembering instructions and completing activities in order has helped me practice using my memory."

She later stated even more strongly:

"I feel that my memory has improved greatly. The repeated brain exercises and robotics activities required me to remember instructions, sequences, and the correct order of each task."

For Chloe the most important recurring theme was order, since she linked memory practice with carrying out instructions and completing activities in sequence.

No Perceived Cognitive Improvement

Claire presented an important contrasting result:

"I have not noticed a major change because I did not have much difficulty remembering those things before. The robotics activities did make me practice remembering instructions and the order of the cards."

She then stated more directly:

"I cannot say that my memory clearly improved. I participated in the activities and used my brain,

but I did not notice a large change in my everyday memory."

What Claire said makes it clear there is a difference between practicing memory and seeing a noticeable improvement in it; although her activities involved her having to remember instructions and sequences, she did not see this as a significant change in her ordinary memory.

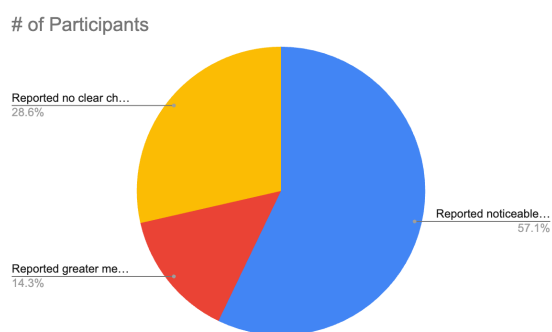
Uncertainty

Andrew similarly remained uncertain:

"I am not certain whether my memory has improved. What I remember most clearly is that the teachers were always kind and that they prepared a delicious meal for us during the final class."

His response suggests that participation did not automatically result in a perceived cognitive improvement for every participant.

Result



The memory hypothesis was thus partially supported.

The interviews indicated that EFMIGO repeatedly required participants to retrieve the instructions, remember the sequences, and keep

the order of the commands. Three of the participants clearly noticed an improvement in their memory, while two others said that they had carried out some memory practice or had greater awareness. Yet Claire and Andrew did not feel there was a clear improvement.

The results therefore support the conclusion that EFMIGO created opportunities for repeated memory practice, but do not demonstrate that every participant experienced the same perceived effect.

Research Question 3: How do AI and robotic devices affect cognitive ability (problem-solving and thinking skills)?

Hypothesis based on earlier research

Research suggests that interactive AI and robotic devices contribute to increased cognitive thinking (Kwan et al. 2021).

The third research question produced the strongest and most consistent pattern in the interviews. The participants frequently stated that the robotics activities had enabled them to concentrate more carefully and to work on problems in a more organized manner. Rather than rushing, they had to consider what the robot was meant to do and then deal with any problems that arose. By going through this process repeatedly, they learned to slow down and pay more attention to problems in a deeper manner.

Cognitive Improvement

Chloe provided one of the clearest descriptions of a change in how she approached problems:

"I now try to solve problems more patiently and systematically. Instead of rushing, I think about each step and complete the task in the correct order."

The statement was important since Chloe was not merely asserting that she had become better at carrying out a robot. She explained a change in the way she tackled problems.

She also explained how the robotics activities encouraged this type of thinking:

"The step-by-step nature of the robotics activities helped my thinking skills. Arranging the programming cards in sequence and observing the robot helped me solve problems carefully."

The fact that these two statements are combined implies that sequencing was one of the major cognitive aspects of Chloe's experience.

Troubleshooting problems

Julie described a similar change:

"I have become more willing to think through problems instead of giving up immediately. I now try to work one step at a time and check what went wrong when the result is different from what I expected."

The response is particularly good evidence of problem-solving since Julie gave a specific account of identifying and correcting errors.

Her robotics response explains why:

"The process of arranging programming cards in sequence and checking the robot's movement

helped me think carefully. It required me to organize my thoughts, follow each step, and identify what needed to be changed."

Julie therefore viewed problem-solving as an active process and not just as a matter of following instructions.

Concentration

Paris emphasized concentration:

"My concentration has improved, especially when I need to remember several steps or coordinate the movements of my hands."

This quotation is particularly relevant to EFMIGO because the activities involved participants having to work through instructions at the same time as they physically handled the materials.

Paris also explained:

"The barcode programming cards helped me think step by step. I had to arrange the commands in the correct sequence, scan them into the robot, and observe whether the robot behaved as expected."

This is yet another example of a process which includes making a prediction and then carrying out an evaluation. The participant had to decide what ought to happen and then compare the result that was expected with the robot's actual movement.

Cognitive Engagement outside Robotics

Similar forms of cognitive engagement were also

beginning to be recognised by the participants in activities outside the field of robotics.

Paris described musical training:

"When learning the cello and flute, I must remember finger positions."

Emily described a much wider range of everyday activities:

"I regularly challenge myself through table tennis, walking, sewing, using my left hand, learning about nature, and participating in robotics activities. These activities require memory, concentration, coordination, and flexible thinking."

Emily also described a specific strategy she used while walking:

"I intentionally use my left hand during meals and try to remember the names of birds, insects, trees, and flowers while walking. When I do not know a name, I look it up on my phone and try to remember it the next time."

It is clear that the participants did not regard cognitive engagement as something which took place only during robotics lessons. They also saw similar processes occurring in music, physical activity, nature, sewing, and other everyday activities.

Uncertainty

Andrew was less certain about improvement:

"I am not sure whether my concentration improved significantly. I sometimes felt frustrated

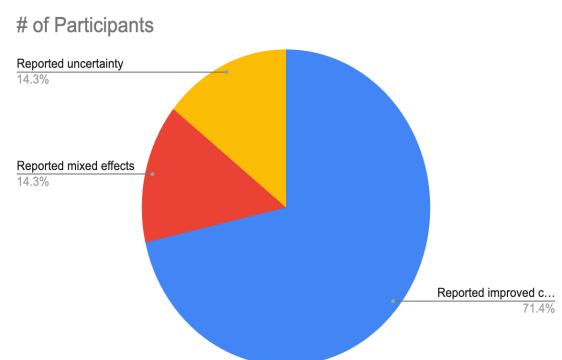
because the other participants seemed to understand the activities better than I did."

Nevertheless, he still recognized that the activities required attention:

"The repeated movements and step-by-step activities encouraged me to pay attention. However, I still found it difficult to fully understand the purpose of some of the EFMIGO activities."

It is important for Andrew's case to show that mentally demanding activities can involve a person without necessarily leading to a positive view of having improved.

Result



Research Question 3 was the most strongly supported by the interview data. Five participants clearly mentioned improvements in their concentration or thinking, one participant said that they had experienced some positive engagement even if the effects were mixed, and Andrew stayed uncertain. Generally, the replies indicate that the most noticeable changes concerned the way in which the participants approached tasks rather than any objective

increase in their intelligence. A number of the participants talked about becoming more focused, patient, and organized when working on problems, in particular when they had to follow a sequence, realize that something was wrong, and then try an alternative solution. These observations show that the main effect of the activities was on cognitive engagement and problem-solving.

Research Question 4: How do AI and robotic devices help contribute to healthy aging

Hypothesis Based on Earlier Research

The older generation who have had positive experiences with AI and robotic devices prove to be supportive of contributing to healthy aging (Noh and Shim 2023).

The fourth research question was concerned with whether the participants linked technology and the EFMIGO activities to more general features of healthy aging. The responses indicated that the participants did not see healthy aging as consisting solely of good memory. On the contrary, they usually associated it with remaining mentally and physically active, and also mentioned feeling more confident, having a greater awareness of their health, and adopting a more positive attitude towards daily life. Six of the participants said that the activities had made some positive contribution to their sense of well-being, while Andrew was uncertain regarding the cognitive effects but did manage to identify other positive aspects of the activities.

Well-Being

Emily provided one of the strongest healthy-aging responses:

"The activities helped me better understand and appreciate my body and mind. I became more interested in maintaining my health, reducing alcohol consumption, exercising, managing stress, and practicing gratitude. I also began praising myself more and accepting my current life with a more positive attitude."

Emily's response extends far beyond cognition. She connected her experience to physical health and a more favorable attitude towards the stage of life she is currently in.

This shows that the participants' understanding of healthy aging was based on a sense of overall well-being rather than just on memory performance.

Brain Health and Confidence

Chloe described another combination of cognitive and emotional effects:

"The activities encouraged me to exercise my brain, practice gratitude, use my non-dominant hand, and think more seriously about maintaining my brain health. They also gave me confidence through repeated practice."

The fact that she included "confidence gained through repeated practice" illustrates the link between healthy aging and the readiness to keep learning new activities.

Cognitive and Social Activity

Kyle stated:

"The activities encouraged me to exercise my brain, think more seriously about my health and diet, practice gratitude, and appreciate myself. They also helped me stay mentally and socially active."

What Kyle says in particular is that staying active has not only a cognitive aspect but also a social one.

Remaining Physically and Mentally Active

Paris similarly stated:

"The activities helped improve my concentration and encouraged me to take better care of my health. Brain exercises, physical exercise, painting, using my left hand, and learning new skills have helped me remain physically and mentally active."

Her response involves concentration as well as exercise, art, physical coordination, and learning.

Uncertainty

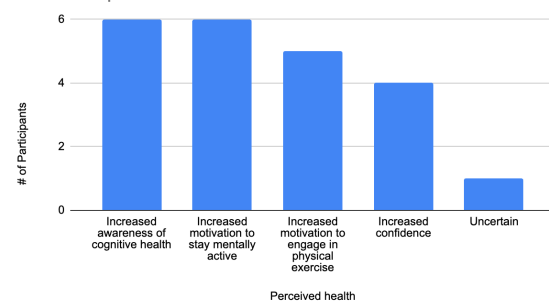
Andrew provided another useful contrast:

"I am not sure about the cognitive effects, but some of the physical activities were helpful. Repeatedly practicing the head-turning exercise appears to have reduced some of the discomfort in my neck. I also appreciated the kindness and effort of the teachers."

Andrew did not report the same degree of cognitive improvement as the rest of them. Yet he did give positive accounts of the physical and interpersonal aspects of the experience.

Result

of Participants vs. Perceived health



Six of the participants said that they had become more aware of their cognitive health and had also become more motivated to keep their minds active. Five of them mentioned that they now had a greater desire to stay physically active and four stated that they had gained more confidence. These findings strongly supported the hypothesis when it came to perceived healthy ageing and well-being. Yet the results do not prove that EFMIGO prevents dementia or causes a clinical reduction in cognitive decline. Rather, they indicate that the majority of the participants linked the activities to increased mental engagement and overall well-being.

Research Question 5: How do elders adapt to the new society of the 4th industrial revolution

Hypothesis Based on Earlier Research

Elders may struggle with unfamiliar technology initially, but repeated practice and direct exposure can encourage them to be more comfortable and confident when using AI and robotic devices (Chen et al. 2020).

The final research question was concerned with how the participants reacted when faced with

unfamiliar technology. Out of the seven participants, five clearly stated that their confidence had increased as a result of taking part in the activities. One participant was already rather familiar with technology, whereas Andrew was still less confident. The results indicated that getting used to the technology involved more than just being given the opportunity to see a robot. Participants frequently said that it was the repeated practice and the opportunity to work directly with the equipment that helped them to feel more at ease, particularly when they were given clear instructions and sufficient time to make and correct their mistakes.

Increased Willingness to Try New Technology

Claire stated:

"I feel more comfortable than before because I have tried assembling and programming robots myself. I am still learning, but I now feel more willing to try unfamiliar technology and continue participating."

This response is significant because Claire demonstrated not just improved skill with one robot, but a broader willingness to engage with unfamiliar technology.

Her earlier comments indicate that, while the technology was unfamiliar, it was not overwhelming.

"I did not experience any major difficulties. The materials were unfamiliar at first, but I followed the teacher's instructions and tried to complete the activities. Arranging the cards and using both

hands required concentration, but I was able to participate."

These statements suggest that manageable challenges, effective instruction, and successful participation contributed to increased confidence.

Confidence

Julie described gaining confidence through personally completing the process:

"I feel more confident because I have practiced assembling robots, organizing programming cards, and checking the results myself."

She also emphasized the importance of instruction:

"The teacher explained the activities kindly and carefully, which helped me continue even when something was unfamiliar. I am grateful for the experience and would like to keep learning."

Julie's response highlights that adaptation relied on both hands-on independence and instructional support.

Familiarity

Chloe stated:

"I feel more confident than before because repeated practice helped me become more familiar with the activities. I believe that continuing to practice consistently will help me improve even more."

Her response directly supports the importance of repetition in adapting to new technology.

Repetition increased confidence

Kyle explained:

"Remembering the correct order and understanding how each command affected the robot required concentration. Some activities were unfamiliar, but repeated practice helped me become more comfortable."

He later reported:

"I feel more confident than before because I have practiced using AI services, interacting with companion robots, and programming physical robots."

Kyle's responses indicate a shift from unfamiliarity to greater comfort through repeated interaction.

Adaptation was not Automatic

Andrew represented the strongest contrasting case:

"The most difficult part was understanding what the activities were and what I was supposed to do. The other participants appeared to understand more quickly, while I often felt confused and frustrated."

His experience shows that exposure to technology alone does not ensure immediate adaptation.

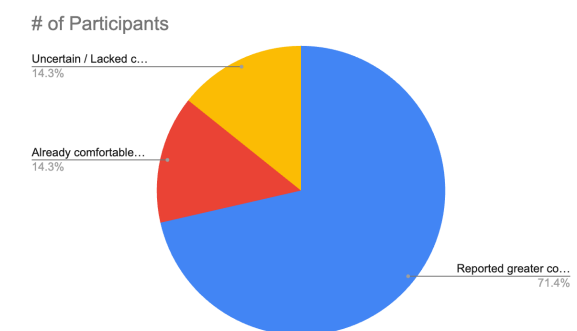
However, Andrew did not reject the technology completely. He later explained:

"I am still not fully confident, but I think I would understand the activities better if I had another opportunity to learn them. I appreciate the

teachers' patience and effort, and I am willing to try again."

This quotation is especially relevant as it illustrates both the limitations of exposure and the value of ongoing support and repetition.

Result



The hypothesis was to some extent supported, there being generally strong evidence overall. While most of the participants said that they had become more confident or at ease, the degree of adaptation varied from person to person. The findings indicate that mere exposure alone was not sufficient and that it was important to have repeated practice as well as ongoing support in order to help the participants get used to the new technology. Andrew's case was particularly significant since it demonstrated that not all older adults will automatically grow comfortable following only a short amount of exposure. Generally speaking, the interviews show that older adults can become more confident when dealing with unfamiliar AI and robotics, but the learning process and the amount of support required can differ from one individual to another.

Discussion

The purpose of this study was to research how older adults experience AI and robotic devices in relation to memory, cognitive ability, and healthy aging. The study examined their adaptation to a technology-centered society. Overall, the interviews suggested that elders who involve themselves in hands-on technological activities experience improved concentration and higher problem-solving skills. As the findings were not identical for every participant, most seniors described noticeable improvements, while some were uncertain about whether their memory or cognitive ability had actually changed. Therefore, the results generally support research from the experts.

Research Question 1: How do elders typically spend their day

My hypothesis was partially supported. The hypothesis presented that older adults would generally have limited exposure to technological devices and might hesitate when using unfamiliar technology. The older adults would soon be accustomed to and comfortable with the new AI and robotic devices presented through repeated experience.

The interviews revealed that seniors were much more technologically exposed than predicted. Most already used smartphones, and several were exposed to ChatGPT, Gemini, and Clova. One participant even interacted with Hyodol, an AI companion robot. At the same time, every participant had little previous experience

assembling robots or programming them through physical cards. Kyle similarly had experience with ChatGPT and Hyodol, but no experience building and programming robots.

These findings remain consistent with the Sil-Bot training and the VR Motor-Cognitive Training articles (Park, Jung, and Lee 2021; Kwan et al. 2021). Like the participants from that study, the EFMIGO participants were capable of engaging with unfamiliar technology and becoming comfortable over time (Park, Jung, and Lee 2021). However, my hypothesis assumed that seniors had very limited exposure to technology. In the articles, participants were already accustomed to general digital technology, and even AI was part of several participants' lives.

The participants' daily routines showed that elders should not be presumed to be viewed as technologically or cognitively inactive. Many exercised, attended welfare-center classes, participated in church activities, played musical instruments, painted, and played table tennis.

Therefore, the hypothesis was partially supported rather than being fully supported. The participants generally had limited experience with robotics, but most participants had some kind of experience with technology in the past.

Research Question 2: How do AI and robotic devices affect memory in older adults?

The results in research question 2 partially supported my hypothesis. The hypothesis predicted that repeated AI and robotic activities

could support memory and cognitive function by requiring elders to repeatedly remember instructions and sequences.

Five of the seven participants described some form of positive memory-related experience, while two participants were uncertain about whether their memory had improved.

The positive findings were closely related to EFMIGO devices. Participants had to repeatedly remember sequences, observe the robot's response, and troubleshoot accordingly. Julia, for example, reported that her concentration and memory gradually improved and explained that arranging programming cards required her to determine a proper solution. Paris similarly reported better recall of appointments and felt that sequencing and repeated actions helped information get recalled faster.

These findings correlate to the Tablet-Based Cognitive Training Article and the Sil-Bot Training Article (Kim et al. 2025; Park, Jung, and Lee 2021). The articles emphasize that repeated technological activities provide opportunities for elders to practice cognitive skills (Kim et al. 2025). The EFMIGO device results suggest a similar approach by requiring participants to remember sequences, figure out problems, and repeat trials till succession.

However, the results do not fully support the hypothesis and earlier research, as Claire stated that she could not see a clear change in her memory improvement. However, she strongly believed that repeated AI and robotic activities

helped her remember and solve sequences more efficiently. Andrew experienced a similar result to Claire, as he was also uncertain whether his memory had improved.

Therefore, the hypothesis is partially supported as the interviews suggest that EFMIGO created repeated opportunities for memory practice. Although most participants realized the clear improvement of their memory, the findings do not demonstrate that all participants perceived benefits from robotic and AI activities.

Research Question 3: How do AI and robotic devices affect cognitive ability, problem-solving, and thinking skills?

The findings in research question 3 were the most strongly supported hypothesis in this study. My hypothesis predicted that interactive AI and robotic activities would strongly contribute to cognitive engagement and problem-solving.

The findings were consistent across sequencing, concentration, and problem-solving. Participants had to assemble robot components, determine the correct order of commands, observe any errors, and revise their sequence. These activities created a continuous cycle of planning, thinking, and testing.

Chloe explained that she became more systematic when solving problems and learned not to rush when thinking through each step. Julie similarly reported becoming more willing to work through problems than follow her normal habit of immediately giving up when a result differed from

what she expected. Paris described increased concentration when recalling several steps and coordinating her hands.

These results are consistent with the Structural Brain Changes Article and the VR Motor-Cognitive Training Article because both articles support the idea that cognitively demanding activities benefit increased cognitive function (Kim et al. 2015; Kwan et al. 2021). The EFMIGO activities similarly combine mental processing with physical interaction as participants use their hands to assemble components while simultaneously remembering instructions and sequencing commands.

One particularly interesting result revealed that participants began recognizing similar cognitive processes outside of robotics. Many mentioned playing musical instruments, sewing, painting, remembering names in nature, using their non-dominant hand, and playing table tennis as alternative ways in which they exercised their concentration and problem-solving skills.

Therefore, the hypothesis was strongly supported by the interview findings. The strongest evidence showed that most participants reported greater concentration and more systematic thinking. The objective wasn't to measure if they became objectively "smarter," but rather to experience an increase in cognitive ability.

Research question 4: How do AI and robotic devices contribute to healthy aging?

The hypothesis in research question 4 was

strongly supported by the participants' perceptions. My hypothesis predicted that positive experiences with AI and robotic devices could contribute to healthy aging and encourage older adults to stay cognitively and physically active.

The participants described benefits extending beyond memory improvement alone. Several mentioned that the activities encouraged them to actively use their brain, remain physically active, and pay greater attention to their health. According to the interviews, six participants reported increased awareness of cognitive health and described greater motivation to stay mentally active. Of those six, five reported increased motivation to engage in physical activities and four experienced increased confidence in daily tasks.

These findings are reflected in the Robot Intervention Meta-Analysis Article, suggesting that AI and robotic interventions may influence other perceived health benefits rather than a single cognitive outcome (Noh and Shim 2023). The EFMIGO participants described these devices and activities as part of a larger pattern of healthy activity.

For example, Emily connected her experiences through exercise, stress reduction, and becoming more positive about her current life. Chloe described increased attention to her well-being, especially her brain health, and through repeated practice of exercises, her confidence increased drastically. Kyle similarly believed that the

activities helped him remain mentally and physically active.

Thus, the results strongly support the hypothesis that technology can contribute to other participants' overall perceived healthy aging and other aspects of their daily lives. The interviews displayed perceived improvements in concentration, confidence, and health awareness, but deep research on dementia prevention would require longer-term studies and more complex machines to measure brain activity (Livingston et al. 2024).

Research question 5: How do elders adapt to the new society of the Fourth Industrial Revolution?

The fifth and final research question was partially supported. My hypothesis predicted that older adults might initially have trouble adjusting to unfamiliar technologies but would eventually become comfortable and confident after repeated use.

Five of the seven participants reported greater confidence after participating in technological activities, while one participant was already relatively comfortable and one remained uncertain. The greatest difficulty the elders had to overcome was understanding instructions, using their non-dominant hands, and remembering programming sequences.

The results align with the Technology Acceptance Article because familiarity and direct exposure appeared to reduce the uncertainty surrounding new technology (Chen et al. 2020). Claire

reported becoming more willing to try unfamiliar technology after letting go of the teacher's direct assistance and programming the robots herself. Likewise, Julie reported increased confidence after practicing robot assembly and programming on her own.

However, Andrew's experience demonstrates that adaptation was not automatic. He remained hesitant and less confident than the others, and frequently found the activities to be hard to grasp, and sometimes even got frustrated when he was the only one who had not finished the task. Nevertheless, he expressed willingness to give the tasks another go. This finding is essential as exposure alone may not be enough for adaptation (Vaportzis, Clausen, and Gow 2017). Older adults need constant repetition, hands-on assistance, and additional time when learning unfamiliar material (Vaportzis, Clausen, and Gow 2017).

Therefore, this hypothesis was partially supported, but the overall evidence was relatively strong. Most participants became more confident and saw a clear change in their confidence, but differences between the participants indicate that successful technological adaptation depends on individual experiences.

Limitations

This study has several limitations to consider. First, the study involved only seven people aged between 70 and 80 who were linked to a single senior welfare center. Since the sample was small and consisted of individuals from one place, the experiences of these participants cannot be taken

as representing all older adults. Moreover, the participants had different daily routines and varied levels of prior experience with technology, and this could have affected how easily they were able to get used to the EFMIGO activities.

Another important limitation is that the study depended mainly on the participants' self-reports obtained during interviews. While the participants were asked if they themselves had felt their memory, concentration, confidence, or general well-being had changed, the study did not feature standardized cognitive tests carried out before and after the activities. Furthermore, there was no control group to compare the results with. As a result, the claims of improvement refer only to what the participants perceived and do not prove that EFMIGO actually led to measurable changes in memory or cognitive ability. This is especially important when dealing with dementia or cognitive decline, since this study did not include clinical testing capable of showing whether such conditions had been prevented or reduced.

The fact that the interviews were of a limited duration also restricted the amount of information that could be gathered; since each one lasted about ten minutes, the participants had only a relatively short time in which to explain their complex experiences relating to memory, technology, and aging. Moreover, the interviews were carried out in Korean and then translated into English. Even though the translation enabled the responses to be analysed and presented in English, there might have been

some differences in meaning or in the wording as a result of the translation process.

Finally, because many of the participants were already physically, socially, and mentally active prior to taking part in EFMIGO, it is not easy to tell whether the effects of the robotics activities were due to EFMIGO or to their other activities. The participants mentioned that they had been exercising, attending classes, learning musical instruments, painting, walking, sewing, and taking part in community activities. These other activities might also have had a beneficial effect on concentration, memory, or general well-being. For this reason, the results should be seen as showing associations among the different aspects of the participants' experiences rather than as proof that the changes reported were caused solely by EFMIGO.

Future Research

Future studies should look into the effects of hands-on AI and robotics activities by involving a bigger and more varied group of older adults. Participants could be recruited from a number of senior centers, and people with different levels of technological experience should be included in order to find out if the patterns identified in this study also occur within a more extensive population. Moreover, a larger sample size would allow researchers to investigate whether factors such as age, prior experience with technology, or level of assistance influence how quickly older adults get used to unfamiliar robotic activities.

Further research could also involve keeping the

participants under observation for a longer period and comparing their abilities before and after they have taken part. In order to do this, standardized tests of memory, concentration, and problem-solving could be carried out together with interviews, allowing the researchers to compare the participants' own perceptions with actual, measurable changes. If a group of people who do not take part in the robotics activities were included, it would be easier to establish whether the changes are specifically due to the intervention or instead attributable to other activities or to the passage of time.

Another important direction for future research would be to examine how the amount of instruction and repetition affects technological adaptation. In this study, it was found that some of the participants got used to the material rather quickly, whereas Andrew kept on having difficulty and thought that if he were given another chance to learn it, it would help him to understand the activities better. Future studies should compare different teaching methods to determine how much repetition and practice time older adults need when learning new technology.

In conclusion, future studies could look at the connection between hands-on robotics and healthy aging over a significantly longer period. Instead of trying to find out if a short program prevents dementia, researchers could investigate whether ongoing participation is linked to changes in cognitive engagement, social participation, confidence, or quality of life over a number of months or years. Interviews combined

with cognitive assessments and other objective measures would offer stronger evidence regarding the possible long-term role of hands-on technology in the lives of older adults.

Conclusion

The study looked into the way older adults experienced hands-on AI and robotics activities in relation to memory, cognitive engagement, healthy aging, and their adaptation to new technology. Generally, the interviews indicate that the effects of taking part in technological activities varied from person to person and according to the particular outcome in question. The results did not demonstrate that the technology brought about the same benefits for all the participants. On the contrary, the most clear pattern was that carrying out repeated hands-on activities provided the participants with opportunities to stay mentally engaged as they were learning and interacting with unfamiliar technology.

The results concerning memory were mixed. Some participants clearly believed that their memory had improved, while others described greater memory practice or awareness without noticing any significant change in their everyday memory. The strongest findings appeared in cognitive engagement and problem-solving. Most participants stated that they had become more focused and more systematic when carrying out tasks since the robotics activities required them to think carefully about each step, observe the robot's response, and make adjustments whenever

the outcome was different from what they had expected. This indicates that one of the most important features of the activities was not merely the use of robotics, but the active thinking that took place when interacting with the materials.

The interviews indicated that the participants linked the activities to wider concepts of healthy aging. Many of them mentioned that they stayed mentally active, became more aware of their own health, and developed a greater sense of confidence as a result of keeping on with the activities. On the other hand, with regard to technological adaptation, it was found that repeated exposure could increase people's comfort level when dealing with unfamiliar AI and robotics, although this process varied from person to person. Andrew's experience was especially significant since the fact that he remained uncertain demonstrated that exposure alone does not automatically result in confidence. Perhaps some older adults need more time and further opportunities to practice.

Overall, this study suggests that hands-on technological activities can give older adults meaningful chances to learn, to think, and to interact with new technology. It must not be understood as proof that EFMIGO prevents dementia or leads to clinical cognitive improvement. Instead, the interviews show that frequent hands-on engagement may help improve people's sense of concentration, their problem-solving abilities, their confidence, and their general well-being, while at the same time assisting some older adults in becoming more at

ease with new technology.

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