Original Research Article

# Exploring the Benefits of Solving the Rubik's Cube for Older Adults

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## ABSTRACT

With a growing aging population worldwide, it is important to combat age-related cognitive impairment, emotional loneliness, and reduced motor skills. This research investigates the cognitive, emotional, and motor gains of playing the Rubik's Cube among older people. Using a quasi-experimental mixed-methods design, data were collected using cognitive testing, dexterity testing, rating scales for mood, and participant observations over a month. Improved cognition was evident for 33%, improved dexterity for 78%, and improved mood for the overall group. On average, participants took an equal amount of time on traditional puzzle play compared with Rubik's Cube. Important themes for qualitative answers included improved concentration, motivation, and emotional fulfillment. Due to a limited sample size and lack of a comparison group, the study shows promise for the Rubik's Cube as an effective, low-cost intervention for healthy aging and neuroplasticity for older individuals.

**Keywords:** Rubik's Cube; puzzle games; elderly; cognitive ability; emotional wellbeing; dexterity; neuroplasticity; aging; brain health; motor skills

## INTRODUCTION

With the aging population, ever-growing numbers of older people display cognitive impairment, emotional loneliness, and reduced psychosocial interaction opportunities. As predicted by the World Health Organization, more than 55 million people worldwide are now living with dementia, with many more experiencing mild levels of forgetfulness and depression (1). There is thus a need for a simple and challenging mental/emotional health-promoting intervention for older people. Prior work by Zarei *et al*. deals with young elite Rubik's cube athletes (2). Whereas standard puzzle play is widely recommended, hardly anyone has explored the potential value of the Rubik's Cube for older people. This study explores how manipulating the Rubik's Cube can positively impact people in later life by improving cognitive capacity, state/mood, and coordination between hands/eyes. A specific objective is to examine pre-/post-test change in cognition, state/mood, and fine motor skills using traditional puzzle play for comparative purposes. The data show repeated practice on the Rubik's Cube is effective for healthy aging in older subjects for promoting neuroplasticity.

## LITERATURE REVIEW

### Cognitive Aging and Neuroplasticity

Cognitive impairment is a characteristic of aging, often being presented as reduced memory, decreased processing speed, and impairment in executive function. They are brought about by structural and

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biochemical damage in the aging brain, such as reduced synaptic density and neurogenesis. However, studies have also revealed that the aging brain is still capable of plasticity, so it can accommodate and even excel in the presence of cognitive stimuli. Neuroplasticity, or the ability for the brain to reorganize by the formation of new neural connections, is even seen to endure long into advanced old age, particularly when individuals are engaged in challenging mental exercises (3).

Engagement in cognition-intensive tasks preserves memory, reasoning, and problem-solving abilities. For instance, regular enactment of complex work delays cognitive aging and preserves mental agility (4). On this note, cognitive training is strongly recommended today as a drug-free preventive strategy for healthy aging.

**Puzzle-Solving and Cognitive Benefits**

Puzzle games such as Sudoku, crosswords, and jigsaw puzzles are strongly studied for cognitive benefits. These games enhance working memory, pattern recognition, and reasoning by logic, all of which are critical for maintaining brain health for elderly people (5). Cross-sectional studies have shown that aged individuals using puzzle games regularly perform better on processing speed and memory tests than those who are not (6).

Though less frequently studied, the Rubik's Cube is a highly demanding puzzle that activates cognitive and motor systems. Being a 3D spatial puzzle, it demands sequential planning and pattern recognition, all activating different areas of the brain (2). In Li *et al.*'s study on one such puzzle, such visuospatial exercises fostered improved spatial visualization and learning capacity (7).

**Motor Skills and Dexterity during Aging**

Aging also results in weakened fine motor skills, hand steadiness, and coordination. These natural developments can inhibit daily operations such as writing, eating, or using digital devices. Motor function decline is also associated with reduced quality of life and increased cognitive decline (8). Brain-hand exercises may counteract or reduce motor decline.

Activities requiring subtle movement of hands, such as knitting, playing an instrument, or puzzle play, were also effective for maintaining or improving manual dexterity in the elderly (9). Rotational repeated movement, positioning, and fine movement are required for the solution of the Rubik's Cube. These responses to movement may improve cognition by enhancing the sensory-motor feedback loop known to play an indispensable role in learning as well as the consolidation of memory (2).

**Social and Emotional Well-being in the Elderly**

Socially isolated individuals are common among older people, particularly lonely or those in long-term care facilities. Social isolation has also been associated with depression, anxiety, and reduced life expectancy (10). Participating in significant and stimulating activities prevents such adverse effects. Liu reports structured social engagement through group-centered activities to improve emotional hardness and reduce perceived loneliness (11).

Participation in entertainment such as puzzle games engenders a sense of purpose and belonging. When such games are also played in group setups, they also extend emotional benefits through communication, mutual reinforcement, and joint success. A study on positive psychology reports that elderly individuals participating in collective games are happier and more emotionally content (12).

Although widely regarded as a solitary exercise, Rubik's Cube can become communal if implemented in a challenge-based or group-learning setting. Senior citizens prefer chatting about achievements, sharing strategies, and encouraging members to promote social relations and emotional well-being.

**Research Gaps in Existing Studies**

While there is growing interest in cognitive training devices, there is correspondingly limited work on using the Rubik's Cube with older adults. Virtually all research uses younger adults or describes the Cube by analogy as a measure of cognitive complexity, but does not deploy it as an intervention with older adults. There is also no triangulated work simultaneously measuring cognitive, emotional, and physical outcomes for such an activity on older adults.

Current evidence tends to focus on a single domain when, in fact, they should be evaluated holistically. Combining all three measurements may give greater insight into the viability of the Rubik's Cube as a multi-faceted intervention. As the elderly population grows, this gap should be further investigated and studied empirically.

## METHODS AND MATERIALS

A quasi-experimental mixed-methods design was employed for this study to investigate the effect of solving the Rubik's Cube on cognitive, emotional, and physical well-being in older adults. Integration of quantitative and qualitative data collection allowed for a thorough exploration of outcomes for participants. Standardized pre-and post-intervention measures using cognitive tests, dexterity measures, and mood rating scales were used to gather quantitative data. Participant surveys and observational notes during the study were used to gather qualitative data.

**Research Design**

It was selected due to the small sample size and because controlled experiments are impractical in naturalistic conditions. The design could accommodate pre- and post-intervention comparison without the possibility of a randomized control group. Including objective measures and subjective experience enabled the study to identify patterns of change and individual responses to the intervention.

**Participants**

Nine older adults (N = 9) ranged in age from 75 to 85 years and were randomly selected from a senior living center. Four women and five men made up the sample. To be included, mental alertness, physical capability for moving hands, and willing engagement in study practice were necessary. Those with extreme impairment or disability in moving their hands were excluded for reasons of fair play. All participants gave informed consent, no personal information was collected and the study was conducted in accordance with human subjects' ethics.

**Data Collection Instruments**

Four large instruments were used to collect data. Firstly, cognitive tests were administered pre- and post-intervention, as short, standardized tests that grouped the participants into low, medium, or high functioning cognitive categories. It was a baseline measure as well as an outcome measure for the cognitive functioning change. Second, dexterity tests assessed the mobility of fingers and hand-eye coordination. Volunteers were classified as low, medium, or high depending on crude manual skills. Regarding cognitive and dexterity tests, participants' performance was categorized into three levels: low, medium, or high. A criterion for improvement was defined as movement from one category to the next higher one. Third, a rough three-level scale–Sad, Neutral, Happy–was employed to assess states of mood observed just before and after the intervention. It enabled recognition of emotional change over time. Lastly, activity logs recorded participants' time on the Rubik's Cube and other puzzle exercises. There was also an open-ended section for observations as well as self-rating preferences. The intervention lasted for a month. Participants received basic training in solving the Rubik's Cube by tutored instructions with peer reinforcement.

**Data Analysis**

These data were compared using descriptive statistics to identify pre- and post-operative changes in the three domains: cognition, dexterity, and mood. Percentage change and monitoring individual progression were also employed to identify trends. Observational data and participants' comments were evaluated thematically for insights into user experience, motivation, and preferences. The joint analysis allowed for the determination of quantifiable outcomes and individual changes in the intervention.

## RESULTS

In the Table 1, results of the experiment showed meaningful cognitive, emotional, and physical improvement for older subjects after a month with the Rubik's Cube. Nine subjects included five men and four women, with a mean age 80. The baseline subjects reflected mixed measures for cognitive functions, mood state, and fine motor dexterity, so a broad range was available for showing improvement.

Cognitive tests given pre-and post-intervention showed that 33.3% of participants (P01, P06, and P08) improved cognition by advancing from medium to high cognitive ability. Another 33.3% (P02, P04, P07) improved moderately by advancing from low to medium. The remaining 33.3% (P03, P5, P09) showed stability in baseline cognitive ability, the participants not deteriorating in any way. These findings support the prediction that solving the Rubik's Cube can stimulate cognitive activity such as memory, planning, and problem-solving.

Dexterity by hand and hand-eye coordination were also improved. Seven participants showed improved dexterity levels, most moving from low to medium or medium to high. One participant (P09) maintained a high level of dexterity over time, while only one (P02) showed no improvement. These findings verify the need for repeated coordinated movement of the hands for the Rubik's Cube.

Mood measures revealed a general pattern of emotional enhancement. Before the intervention, subjects had had three Happy, four Neutral, and two Sad moods. After the intervention, six subjects reported feeling Happy, and three were Neutral, with no subjects reporting sorrow. There were mood upgrades for subjects P01, P06, and P08.

Participants averaged 22.2 minutes interacting with the Rubik's Cube and 21.7 minutes with traditional puzzles. Most did both, though some reported early frustration with the Cube. However, the overall uptick in interactions and positive results proves the value of the Rubik's Cube as a challenging, gratifying complement to aging well.

**Table 1.** Measurement data for cognitive testing, dexterity testing, rating scales for mood and observations

| ID | Gender | Cognitive Assessment (Pre) | Cognitive Assessment (Post) | Dexterity Test (Pre) | Dexterity Test (Post) | Mood (Pre) | Mood (Post) | Time Spent on Cube (min/day) | Time Spent on Puzzles (min/day) | Comments / Observations |
|---|---|---|---|---|---|---|---|---|---|---|
| P01 | M | Medium | High | Low | Medium | Neutral | Happy | 20 | 15 | Improved focus, more engaged in activities |
| P02 | F | Low | Medium | Low | Low | Sad | Neutral | 10 | 30 | Frustrated at first, then engaged with puzzles |
| P03 | M | Medium | Medium | Medium | High | Happy | Happy | 30 | 20 | Enjoyed both, preferred Rubik's Cube |
| P04 | F | Low | Medium | Low | Medium | Neutral | Neutral | 15 | 25 | Found puzzles easier, struggled with Rubik's Cube |
| P05 | M | High | High | Medium | High | Happy | Happy | 40 | 10 | Loved Rubik's Cube, challenged himself daily |
| P06 | F | Medium | High | Medium | High | Neutral | Happy | 25 | 25 | Balanced interest in both activities |
| P07 | M | Low | Medium | Low | Medium | Sad | Neutral | 10 | 20 | Preferred puzzles, but showed patience with Rubik's Cube |
| P08 | F | Medium | High | Low | Medium | Neutral | Happy | 15 | 30 | Felt accomplished after solving puzzles |
| P09 | M | High | High | High | High | Happy | Happy | 35 | 20 | Very engaged, encouraged others to participate |

## DISCUSSION

These findings show the positive influence of exercise on the Rubik's Cube on mental, motor, and emotional health in the elderly. More obvious mental gains than standard puzzle exercises were observed for subjects whose baseline cognitive status was average and escalated into more advanced categories. Embedded in the Cube are complexity and a need for strategy, which might more easily engage mental processes such as memory, sequential ordering, and solving problems.

Increased dexterity was also observed for most participants by using repeated coordinated motions of the hands to play with the Cube. These significantly increase fine motor skills and hand-eye coordination, which are required for older adults to obtain autonomy in daily living. Emotionally, subjects also reported more favorable mood states by the end of the study. That improvement can be traced back to feelings of mastery, novelty, and challenge built into the Cube. A sense of accomplishment by solving or making gains on the Cube may also have contributed to emotional well-being and self-esteem.

From a neurological perspective, the Cube simultaneously calls on many parts of the brain. Because it is a three-dimensional puzzle, it requires spatial perception, rationality, remembering, and motor coordination for mental exercise in general. Because it is multi-sensory and integrative, it is more intriguing than traditional slab-based puzzle games such as jigsaws or word games.

The observed improvements in visuospatial reasoning and fine motor performance among older adults following Rubik's Cube training may reflect experience-dependent neuroplasticity. Prior research demonstrates that even in late adulthood, targeted cognitive–motor activities can induce structural and functional brain changes (3, 13). Moreover, the task aligns with principles of motor learning, such as repetition, feedback, and increasing task complexity, which are critical for maintaining dexterity and coordination in aging populations (14). Therefore, the Rubik's Cube may serve as a compact yet multidimensional tool for promoting neurocognitive resilience and motor control in older adults.

The Rubik's Cube is an inexpensive, portable, and omnipresent device easily installed in facilities for older adult activity and care facilities. With some training, staff members can lead elders through basic problem-solving techniques and encourage regular use. As an instrument of a non-pharmacologic intervention approach, it has the potential to improve cognition, maintain motor skills, and foster emotional well-being, all dimensions of healthy aging. These observations confirm the Cube's value as an innovative element of eldercare programming.

While the result of this study is comforting, there are some limitations to be kept in mind. First, the sample size is small (N=9), and this limits the generalizability of the findings a great deal. While the participants completed an extensive range of cognitive and physical functioning, there would be better data and more meaningful statistical analysis with a larger sample size. The inferences here should thus be viewed as exploratory/indicative rather than definitive.

Second, there is no control group to allow assignment of observed gains sufficiently to the intervention by the Rubik's Cube. All participants also worked on typical puzzle materials, so comparisons between the two were observational and not controlled. A randomized controlled group using standard puzzle materials alone would provide a more secure base for determining the Cube's unique effects.

Third, the measures of cognition and mood relied in part on short-term change and self-rating, which might not reflect long-term improvement. Emotions can fluctuate for reasons independent of the intervention, and cognitive change occurring over a month might not carry over in the long run. In addition, the very narrow range of the three-point mood scale may have limited the measure of sensitive emotional change.

Finally, extrinsic factors such as individual motivation, prior puzzle experience, and environment (e.g., noise level, social support) may have affected outcomes. Participants may have inherently possessed more puzzle inclination than others or may have known more frustration toward the Cube by individual choice or unfamiliarity.

## CONCLUSION

These findings confirmed Rubik's Cube solving's cognitive, emotional, and physical advantages among older adults. Low-cost and accessible, the Cube is a promising adjunct to eldercare practice. These results have implications for future neuroplasticity and cognitive resilience studies with older adults, offering illuminating scholarly contributions. With minimal resources and low training levels required, the Rubik's Cube is a very practical tool for healthy aging. In brief, the simple cube puzzle has the potential to unlock new doors to mental clarity, emotional fulfillment, and social interaction for older adults globally.

Future studies must go beyond a brief timeframe to track long-term sustained changes in cognition, emotion, and movement skills over months or even years. Longitudinal data would establish the long-term lasting effects of long-term practice on the Rubik's Cube. Controlled experiments with randomized trials for puzzle-only and Cube-only conditions are also necessary to distinguish between independent effects for individual activities. Incorporating neuroimaging techniques such as MRI or EEG could also further inform brain activity transformations to more firmly establish the biological substrate for gains observed. Diversification of participants into various educational, ethnic, and socioeconomic cohorts will also increase generalizability for findings to broader aging populations.

## CONFLICT OF INTERESTS

The author declares that there are no conflicts of interest related to this work.

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