

Design Characteristics of Rehabilitation Playthings to Reduce Neuropsychiatric Symptoms of Alzheimer's Patients for Improving Well-Being Among Patients and Caregivers

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Abstract. Play therapy has emerged as a treatment approach to address a broad range of emotional and behavioral issues. Specifically, rehabilitation playthings (RPT) have demonstrated significant benefits in reducing Neuropsychiatric Symptoms (NPSs) among Alzheimer's patients. However, there is currently a lack of comprehensive research on the design and characteristics of RPT. To address the gap, this study aims to identify and determine the key characteristics of RPT tailored for Alzheimer's patients to alleviate neuropsychiatric symptoms. The systematic literature review synthesis method was employed in this study. The findings suggested that RPT for emotional shaping, goal-directed activity, music therapy, multisensory stimulation, cognitive stimulation therapy, and need-based intervention characteristics by multi-player, tangible, social interaction, and sensory stimulation could reduce NPSs and caregiver burden. This study contributes to the design of rehabilitation plaything (RPT) for reducing NPSs, which is directly associated with the well-being of both patients and caregivers.

Keywords: Rehabilitation playthings; Alzheimer's Disease; Neuropsychiatric symptoms; well-being, Design characteristics.

1. Introduction

Alzheimer's Disease (AD) is a progressive neurodegenerative disorder that impairs cognitive functioning, including memory, language, judgment, and visuospatial skills, which become the most common type of late-life mental impairment in people. As a result, individuals with AD often become increasingly dependent on caregivers and may experience social isolation and face some mood disorders. Neuroscience research has shown a correlation between cognition and emotion. Neuropsychiatric symptoms (NPSs) like depression, agitation, apathy, and sleep disorder have a significant impact on daily functioning and overall quality of life. These syndromes overlap with one another. [1] According to certain studies, patients with more frequent and severe NPS were more likely to be looked after by caregivers who were under higher stress. [2] Family caregivers are at risk for a decline in psychological health. [3] At present, clinicians are increasingly adopting play therapy (PT) as a treatment approach to address a broad range of emotional and behavioral issues. [4] Playfulness is an essential

component of Alzheimer's Disease care and provides ideas for new and valuable ways of interacting and being with individuals with the condition. Rehabilitation playthings (RPT) and leisure activities have been proven beneficial for Alzheimer's patients and caregivers. However, most of the research on Alzheimer's disease primarily resides within the medical domain. This knowledge gap presents a significant challenge that designers grapple with when endeavoring to design for AD patients. The complexity of AD, coupled with its multidimensional impact on individuals and their families, necessitates a harmonious fusion of design principles and medical insights, which can be a formidable hurdle to overcome. Navigating the intersection of these two domains poses a substantial challenge for designers seeking to make meaningful contributions to the field of AD care and support.

Research on design area has demonstrated the value of emotional knowledge in design practices. Emotional design, design for positive emotions, compassionate design, and user experience are design principles that have garnered substantial attention and recognition in recent years, largely because of their fundamental emphasis on understanding and catering to users' emotional states and experiences. Considering this growing awareness of the pivotal role of emotions in design, this study has put forth the proposition to tackle emotional issues, such as neuropsychiatric symptoms (NPSs), in the context of Alzheimer's disease through rehabilitation playthings (RPT) design. Therefore, understanding the characteristics of RPT for reducing NPSs among AD patients is crucial for RPT design.

2. Material and Methods

Based on its objective, this study conducted a literature review on particular subjects. The research question (RQ) construct classification technique [5] was used to determine the keywords. This technique identifies three separate RQ Constructs—"WHO", "WHAT," and "HOW"—in developing a core research question. Ibrahim explains the "WHO" construct as the object utilized in or affected by a piece of research, the "WHAT" construct as the data needed to answer a research question, and the "HOW" construct as the action taken with respect to the object used in or affected by the data of the research. This study selected related articles under the "HOW" construct, reduced neuropsychiatric symptoms (NPSs) for reporting. The literature articles were identified using SCOPUS, Google Scholar, and Science Direct. Using the keywords related to the selected major themes such as therapy AND Alzheimer's disease, caregivers' coping strategy, and rehabilitation playthings. The most pertinent sub-themes were chosen after reviewing the abstracts. The results of this exercise resulted in a synthesis summary for each major theme, which was then cross analyzed, integrated with potential solutions, and prioritized toward the most likely options for developing RPT for Alzheimer's patients. Following that, Ibrahim's "Point of Departure (POD) Tree Diagram", which has been adjusted, is used to provide the final key synthesized summaries. The discussion of potential integrated solutions for the establishment of a theoretical framework for future research concludes this study.

3. Reduce Neuropsychiatric Symptoms

3.1 Therapy for reducing NPSs

NPSs are pervasive in Alzheimer's disease, impacting nearly every patient with significant ramifications and correlating with heightened caregiver distress. The creation of innovative therapies for AD that target NPSs is crucial. Presently, a definitive cure for dementia remains elusive; individuals afflicted with this condition must depend on pharmaceutical interventions and healthcare services to mitigate the advancement of the ailment. Nonetheless, the cost of drug therapies and medical attention for those affected by dementia is considerably high. Hence, the efficacy and affordability of social psychological interventions have garnered considerable research interest from numerous scholars.

Domenico et al emphasized emotional shaping can change patients' motivation to act. [6] People may wish to engage in an activity more if it is connected to a pleasant outcome. Gulliver et al stated that the Music Engagement Program can increase engagement and participation in the act of music-making, improve social interaction, improve mood calmness, and reduce aggression.[7] McDermott supported the impact of music therapy on Alzheimer's patient's cognitive function, depression, and anxiety levels. [8] Multisensory stimulation Snoezelen has been shown to be effective in managing short-term behavior in the elderly with moderate to severe AD. [9] These support the unmet needs of sensory stimulation. Chen et al stated that cognitive stimulation therapy will improve the ability to perform activities of the daily life of AD patients and significantly improve cognitive performance. [10] Hui et al highlighted cognitive stimulation therapy based on cultural adaptations. [11] García-Alberca asserted that cognitive-behavioral therapy encompasses elements such as instruction, self-awareness, self-encouragement for managing emotions, encouraging active engagement in activities, problem-solving intervention, physical activity, and caregiver guidance, which can be advantageous for addressing depression, anxiety, and caregiver stress. [12] These supported that cognitive function is related to NPSs. Christofolletti et al asserted that engaging in regular physical activity has demonstrated the potential to enhance the structure of sleep, leading to increased sleep depth and duration. [13] Scherder et al supported physical activity to reduce NPSs, highlighting the reduction of agitation. [14]The physical activities related to unmet needs of daily activities. Bisiani & Angus stated the effectiveness of doll therapy in reducing problematic behaviors like agitation and anxiety that are linked to previously noticed attachment requirements. [15] However, some researchers hold the view that using dolls is unethically unfair and could be seen as a person's second childhood, which would dehumanize and infantilize them.

Finally, Bédard et al stated that the need-based intervention is structured by comfort, social interaction, and sensory stimulation to reduce verbal agitation. [16] Cohen-Mansfield et al emphasized that identifying unfulfilled requirements serves as a foundation for creating programs aimed at addressing these needs. On average, each resident exhibited three unmet needs. These needs commonly included feelings of ennui, lack of sensory stimulation, feelings of isolation, and the desire for meaningful activities. [17]

In general, this study agrees that cognitive function is related to emotion, cognitive stimulation therapy improves the ability to perform activities of daily life and reduces NPSs. Moreover, this study supports the view of Bédard and Cohen-Mansfield by considering unmet needs in the intervention of NPSs including physical activities. Then, this study will include sensory stimulation by music. In the end, this study suggests that need-based intervention structured by

comfort, social interaction, and sensory stimulation including emotional shaping, music therapy, physical activities, music therapy, and cognitive stimulation therapy could reduce NPSs.

3.2 Caregivers' coping strategy in reducing NPSs.

Caregivers play an important role in Alzheimer's disease care. Pfeifer et al stated that caregiver confidence and a tendency to downplay challenges faced by AD patients may have a favorable effect on the incidence of apathy. [18] Fazio et al highlighted the importance of emphasizing behavioral support and understanding behaviors as expressions. [19] Kitwood & Bredin highlighted that recognizing personhood plays a pivotal role in person-centered care and aims to promote more positive interactions with people and everyone around them. [20] The goal is to promote well-being and a sense of belonging, as it is essential for everyone to experience a personal sense of purpose in their life. Semiatin & O'Connor highlighted the importance of identifying the factors associated with recognizing the positive aspects of caregiving is crucial for improving caregiver well-being, which is linked to their high self-efficacy. [21] Smebye & Kirkevold highlighted connections that upheld one's sense of self were the intimate emotional ties between caregivers and individuals with Alzheimer's disease. [22] These strong family relationships were defined by shared affection, trust, and mutual respect. Gallagher et al indicated that self-efficacy in managing symptoms served as an intermediary factor connecting a patient's neuropsychiatric symptoms to the caregiver's burden and depression symptoms. [23] García-Alberca et al highlighted that coping strategies are related to caregiver burden and NPS of patients. The intervention should include engagement coping strategies.

Therefore, caregivers' self-efficacy for NPSs management to improve positive perception, engagement coping strategies, and personhood in person-centered care conceptualizes behaviors as expressions and focuses on behavioral support could reduce NPSs and improve caregivers' well-being.

3.3 The Characteristics of RPT to reduce NPSs.

Rehabilitation playthings like serious games, dolls, and pet-type robots have been proven to be beneficial for reducing NPSs. Mahmud et al stated that utilizing physical gameplay alongside an element of guessing within a tabletop game effectively promotes social engagement and enhances the enjoyment factor. [24] This, in turn, complements therapy aimed at addressing unmet social interaction needs. Benveniste et al highlighted MINWII-a serious video game based on music therapy, focusing less on creativity but more on reminiscence and renarcissization to make use of whatever capabilities they may still have. [25] McDermott et al highlighted that the effects of Music Go beyond merely alleviating NPSs. Nurturing musical and interpersonal connections can contribute to appreciating an individual's identity and preserving their overall well-being. Furthermore, understanding each person's musical background holds significance. Jakob & Collier highlighted sensory stimulation by textile, including advanced textile technology as tactile dialogues to promote and foster non-verbal communication by facilitating shared interaction with the product, thereby enhancing social connections. [26] This aligns with the idea of using sensory stimulation to alleviate negative psychological symptoms. Houben et al highlighted everyday sounds that could evoke personal connections, memories, or a resurgence of past experiences, along with emotionally charged reactions. [27] This study supports this view to combine reminiscence and sensory stimulation. Zheng et al highlighted that active game like the Kinect game Fruit Ninja was effective in

enhancing the quality of life and reducing depression in individuals with Alzheimer's disease. [28] Engaging in active gameplay combines enjoyable social and cognitive challenges with competitive physical activities.

In general, to reduce NPSs, the characteristics of playthings should include multi-player, tangible play, cognitive pleasant, and competitive activities to facilitate social interaction and fun. Sensory stimulation with everyday sound to trigger emotional memories, and textile technology to encourage non-verbal communication.

4. Discussion

This section cross-analyses integrates possibilities and prioritizes the synthesized literature review summaries under the thematic theme of reducing neuropsychiatric symptoms (NPS) towards highly probable solutions for how to develop RPT design strategy to reduce NPSs among Alzheimer's patients.

4.1 Improving dementia care through comprehensive strategies.

After the above research, POD1 was developed: need-based intervention structured by comfort, social interaction, and sensory stimulation including emotional shaping, music therapy, physical activities, and cognitive stimulation therapy could reduce NPSs. POD2 was proposed as follows: Caregivers' self-efficacy for NPSs management to improve positive perception, engagement coping strategies, and personhood in person-centered care conceptualizes behaviors as expressions and focuses on behavioral support could reduce NPSs and improve caregivers' well-being. Therefore, this study developed POD4: Caregiver engagement coping strategy, self-efficacy, positive perception, and person-centered care with need-based intervention structured by comfort, social interaction, and sensory stimulation including music therapy, multisensory stimulation, and cognitive stimulation could reduce NPSs.

4.2 The characteristics of RPT for intervention

POD3: To reduce NPSs, the characteristics of RPT should include multi-player, tangible play, cognitive pleasant, competitive, and sensory stimulation with everyday sound to trigger emotional memories, and textile technology to encourage non-verbal communication. Combined with POD1 developed POD6 as follows: To reduce NPSs, the playthings for need-based intervention include emotional shaping, music therapy, physical activities, and cognitive stimulation therapy with the characteristics of multi-player, tangible play, cognitive pleasant, competitive, and sensory stimulation.

4.3 The characteristics of RPT and caregivers' coping strategies

The plaything design also needs to support caregivers' coping strategies. Therefore, this study combined POD2 with POD3 to develop POD5: The playthings based on caregiver self-efficacy, positive perception, engagement coping strategies characteristics with multi-player, tangible, social interaction, sensory stimulation, reminiscence for reducing NPSs and caregiver burden.

4.4 RPT for intervention

Then, combining the contents of POD4 and POD5 proposed POD7: RPT for emotional shaping, goal-directed activity, music therapy, multisensory stimulation, cognitive stimulation therapy, and need-based intervention characteristics by multi-player, tangible, social interaction, everyday sound, and emotional memories as engagement coping strategy, could improve caregiver's self-efficacy, positive perception, person-centered care for reducing NPSs and caregiver burden.

4.5 RPT for caregiver

POD5 and POD6 have many common elements. Combining POD5 and POD6, this study developed POD8: RPT to improve caregiver self-efficacy, positive perception, engagement coping strategies characteristics with multi-player, tangible, social interaction, sensory stimulation, reminiscence as emotional shaping, goal-directed activity, music therapy, multisensory stimulation, cognitive stimulation therapy, and need-based intervention for reducing NPSs and caregiver burden.

4.6 RPT to Reduce NPSs

This study identified shared elements between POD7 and POD8, subsequently merging their respective perspectives. Hence, the study proposed the final POD9: RPT for emotional shaping, goal-directed activity, music therapy, multisensory stimulation, cognitive stimulation therapy, and need-based intervention characteristics by multi-player, tangible, social interaction, and sensory stimulation could improve caregiver's self-efficacy and person-centered care for reducing NPSs and caregiver burden. Figure 1. shows how the literature review synthesis developed the final point of departure for the characteristics of RPT to reduce NPSs.

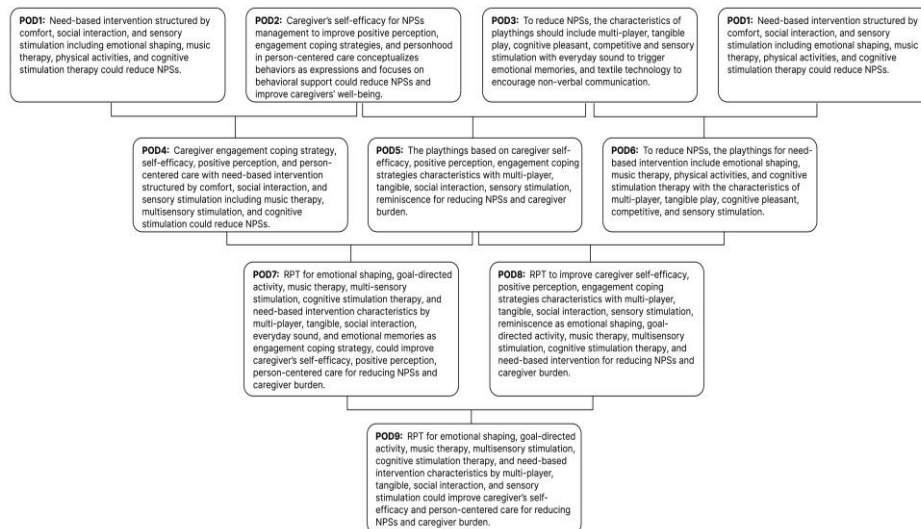


Fig.1. Point of Departure (POD) Tree Diagram for Study on reducing neuropsychiatric symptoms (NPSs)

5. Conclusion

The aim of this paper is to determine the characteristics of RPT, which is crucial for RPT design for improving well-being among both AD patients and caregivers. This paper documents the results of a systematic literature review synthesis process under the thematic theme of reducing neuropsychiatric symptoms (NPS). Further synthesis of the above results concluded that RPT for emotional shaping, goal-directed activity, music therapy, multisensory stimulation, cognitive stimulation therapy, and need-based intervention characteristics by multi-player, tangible, social interaction, and sensory stimulation could improve caregiver's self-efficacy and person-centered care for reducing NPSs and caregiver burden. Further study is recommended for conducting a meta-analysis exercise on the literature supporting the proposed theoretical proposition. In addition, future study is recommended for incorporating the results into rehabilitation playthings design.

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References

- [1] Geda, Y. E. *et al.*: Neuropsychiatric symptoms in Alzheimer's disease: Past progress and anticipation of the future. *Alzheimers Dementia.*, vol. 9, no. 5, pp. 602–608 (2013)
- [2] García-Alberca, J. M. *et al.*: Neuropsychiatric Symptoms in Patients with Alzheimer's Disease: The Role of Caregiver Burden and Coping Strategies. *Am. J. Alzheimers Dis. Dementiasr*, vol. 29, no. 4, pp. 354–361 (2014)
- [3] Hallikainen, I., Koivisto, A. M., & Välimäki, T.: The influence of the individual neuropsychiatric symptoms of people with Alzheimer disease on family caregiver distress-A longitudinal ALSOVA study. *Int. J. Geriatr. Psychiatry*, vol. 33, no. 9, pp. 1207–1212 (2018)
- [4] Thomas, S., White, V., Ryan, N., & Byrne, L.: Effectiveness of play therapy in enhancing psychosocial outcomes in children with chronic illness: A systematic review. *J. Pediatr. Nurs.*, vol. 63, pp. 72–81 (2022)
- [5] Ibrahim, R.: Demystifying the Arduous Doctoral Journey: The Eagle Vision of a Research Proposal. *Electron. J. Bus. Res. Methods*, vol. 9, no. 2, pp. 130–140 (2011)
- [6] Domenico, A. Di., Palumbo, R., Fairfield, B., & Mammarella, N.: Fighting apathy in Alzheimer's dementia: A brief emotional-based intervention. *Psychiatry Res.*, vol. 242, pp. 331–335 (2016)
- [7] Gulliver, A. *et al.*: The Music Engagement Program for people with Alzheimer's disease and dementia: Pilot feasibility trial outcomes. *Eval. Program Plann.*, vol. 87, pp. 1-11(2021)
- [8] McDermott, O., Orrell, M., & Ridder, H. M.: The importance of music for people with dementia: the perspectives of people with dementia, family carers, staff and music therapists. *Aging Ment. Health*, vol. 18, no. 6, pp. 706–716 (2014)
- [9] Sánchez, A. *et al.*: Comparing the Effects of Multisensory Stimulation and Individualized Music Sessions on Elderly People with Severe Dementia: A Randomized Controlled Trial. *J. Alzheimers Dis.*, vol. 52, no. 1, pp. 303–315 (2016)
- [10] Chen, X.: Effectiveness of cognitive stimulation therapy (CST) on cognition, quality of life and neuropsychiatric symptoms for patients living with dementia: A meta-analysis. *Geriatr. Nur. (Lond.)*, vol. 47, pp. 201–210 (2022)

- [11] Hui, E. K *et al.*: Virtual individual cognitive stimulation therapy in Hong Kong: A mixed methods feasibility study. *Geriatr. Nur. (Lond.)*, vol. 47, pp. 125–134 (2022)
- [12] García-Alberca, J. M. : Cognitive-behavioral treatment for depressed patients with Alzheimer's disease. An open trial. *Arch. Gerontol. Geriatr.*, vol. 71, pp. 1–8 (2017)
- [13] Christofolletti, G *et al.*: Physical activity attenuates neuropsychiatric disturbances and caregiver burden in patients with dementia. *Clinics*, vol. 66, no. 4, pp. 613–618 (2011)
- [14] Scherder, E. J. A *et al.*: The more physical inactivity, the more agitation in dementia. *Int. Psychogeriatr.*, vol. 22, no. 8, pp. 1203–1208 (2010)
- [15] Bisiani, L. & Angus, J.: Doll therapy: A therapeutic means to meet past attachment needs and diminish behaviours of concern in a person living with dementia – a case study approach. *Dementia*, vol. 12, no. 4, pp. 447–462 (2012)
- [16] Bédard, A *et al.*: Reducing verbal agitation in people with dementia: Evaluation of an intervention based on the satisfaction of basic needs. *Aging Ment. Health*, vol. 15, no. 7, pp. 855–865 (2011)
- [17] Cohen-Mansfield, J. *et al.*: Which unmet needs contribute to behavior problems in persons with advanced dementia? *Psychiatry Res.*, vol. 228, no. 1, pp. 59–64 (2015)
- [18] Pfeifer, L *et al.*: Caregiver perception of apathy in persons with mild cognitive impairment or Alzheimer's disease: a longitudinal study. *Aging Ment. Health*, vol. 21, no. 5, pp. 494–500 (2017)
- [19] Fazio S. *et al.*: What Is Really Needed to Provide Effective, Person-Centered Care for Behavioral Expressions of Dementia? Guidance from The Alzheimer's Association Dementia Care Provider Roundtable. *J. Am. Med. Dir. Assoc.*, vol. 21, no. 11, pp. 1582–1586 (2020)
- [20] Kitwood, T. & Bredin, K.: Towards a Theory of Dementia Care: Personhood and Well-being. *Ageing Soc.*, vol. 12, no. 03, pp. 269–287 (1992)
- [21] Semiatin, A. M. & O'Connor, M. K.: The relationship between self-efficacy and positive aspects of caregiving in Alzheimer's disease caregivers. *Aging Ment. Health*, vol. 16, no. 6, pp. 683–688 (2012)
- [22] Smebye, K. L. & Kirkevold, M.: The influence of relationships on personhood in dementia care: a qualitative, hermeneutic study. *BMC Nurs.*, vol. 12, no. 1, p. 29 (2013)
- [23] Gallagher, D. *et al.*: Self-efficacy for managing dementia may protect against burden and depression in Alzheimer's caregivers. *Aging Ment. Health*, vol. 15, no. 6, pp. 663–670 (2011)
- [24] Mahmud, A. A., Mubin, O., Shahid, S., & Martens, J.-B.: Designing social games for children and older adults: Two related case studies. *Entertain. Comput.*, vol. 1, no. 3–4, pp. 147–156 (2010)
- [25] Benveniste, S., Jouvelot, P., Pin, B., & Péquignot, R.: The MINWii project: Renarcissization of patients suffering from Alzheimer's disease through video game-based music therapy. *Entertain. Comput.*, vol. 3, no. 4, pp. 111–120 (2012)
- [26] Jakob, A., & Collier, L.: Sensory Design for Dementia Care – The Benefits of Textiles. *J. Text. Des. Res. Pract.*, vol. 5, no. 2, pp. 232–250 (2017)
- [27] Houben, M *et al.*: Foregrounding Everyday Sounds in Dementia. in *Proceedings of the 2019 on Designing Interactive Systems Conference*, San Diego CA USA: ACM. pp. 71–83 (2019)
- [28] Zheng, J., Yu, P., & Chen, X.: An Evaluation of the Effects of Active Game Play on Cognition, Quality of Life and Depression for Older People with Dementia. *Clin. Gerontol.*, vol. 45, no. 4, pp. 1034–1043(2022)