

# Increasing Engagement and Positive Emotional Behavior of Older Adults with Mild-moderate Dementia with the Use of Motion-based Technology and Meaningful Activities

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## ABSTRACT

**Aim:** This study investigated if adults with dementia who engaged in self-selected motion-based games demonstrated higher indicators of engagement than those who engaged in the typically offered activities. **Methods:** This randomized quasi-crossover design included 33 participants with mild-moderate dementia who attended adult day care. Data was collected over 10 weeks. The experimental groups engaged in self-selected Magic Table and Wii games while the control group participated in everyday activities offered at the center. The Assessment of Quality of Activities (A-QOA) was used to evaluate the level of engagement in the activities. **Results:** Median total summed scores were significantly higher for both the Magic Table and Wii games when compared to the control group. Qualitative data indicated enhanced social interaction and positive self-expression. **Conclusions:** These findings seem to suggest that both the Magic Table and Wii games are both therapeutic activities for individuals with mild to moderate dementia.

**Keywords:** Occupational Therapy, Dementia, Adult Day Care, Engagement, Motion-Based Activities

## INTRODUCTION

Alzheimer's Disease, "the most common type of dementia", is becoming more prevalent in the United States [1]. There are currently approximately 6.7 million Americans, or 1 in 9 adults aged 65 and older, who are living with dementia [2]. Dementia is a condition characterized by a progressive loss of intellectual functioning that causes a decline in one's executive functions, memory, attention skills, learning, language, perceptual-motor abilities, and social cognition [3,4]. Moreover, these deficits are so significant that they can cause occupational dysfunction, which is defined as challenges related to daily occupational activities [5]. Initially, the first indicators of dementia are

commonly related to difficulties performing instrumental activities of daily living (IADLs), such as managing finances, shopping, meal preparation, health, home, and medication management [3]. As the disease progresses, it typically begins to interfere with one's basic activities of daily living (BADLs), such as dressing, bathing, toileting, and feeding [3]. Other areas that are frequently impacted include one's sleep, leisure, social participation, and ability to work or volunteer [3].

Significant impairments in many areas of occupational performance often result in the individual with dementia being unsafe to live alone [3]. However, individuals with dementia typically prefer to reside within their own home for as long as possible [6]. Additionally, staying in one's home is a more cost-effective option compared to an inpatient memory care unit or a nursing home [7]. Adult day care can be a viable option for individuals preferring to reside in their homes after a dementia diagnosis. Adult day care centers are community-based programs designed to provide care and companionship for older adults who need assistance or supervision during the day [8]. Additionally, adult day care centers provide therapeutic activities and enriched opportunities for individuals with dementia, but they also provide much-needed support, respite, and resources for family caregivers [9]. Furthermore, since an interdisciplinary professional team often operates many adult day care facilities, they are able to provide their clients with healthcare monitoring, leisure activities, socialization opportunities, as well as assistance with basic ADLs [10]. Adult day care programs are an affordable alternative to traditional long-term care placements. Moreover, adult day care centers can reduce out-of-pocket healthcare expenses, lessen the use of high-cost centers, and have the potential to delay institutionalization secondary to their interdisciplinary focus on person-centered care (PCC) [11]. In addition to the provision of an enriched environment for individuals with dementia, adult day care centers can also be extremely beneficial for the family and/or caregivers. For example, adult day care centers offer breaks for caregivers and allows them the time to perform other tasks and responsibilities and/or engage in their own meaningful occupations and interests. Research has shown that caregivers who are able to take care of their own needs have a higher likelihood of providing better care to individuals with dementia and are at lower risk to engage in elder abuse [12]. In addition to providing much-needed breaks for the caregiver, day care programs can also offer support groups and a variety of educational programs [13]. This enables the caregiver to learn more about their loved

one's condition and learn about better ways to support them in their daily life [13].

### Maladaptive Behaviors

Due to a number of reasons, individuals with dementia can often experience some significant behavioral changes. For example, maladaptive behaviors such as a flat affect, negative facial expressions, physical aggression, and general combativeness towards caregivers can occur [14]. These personality changes can manifest as frustration related to everyday challenges [15]. Approximately 80% of persons with dementia experience some form of behavioral and psychological symptoms [16]. These behaviors are typically addressed using medications such as antidepressants and prescriptions to address anxiety [17]. However, medication alone has not been effective in eliminating the presence of maladaptive behaviors for individuals with dementia. As a result, non-pharmacologic interventions are beginning to emerge as an alternative strategy for not only addressing the behavioral and psychological symptoms of dementia, but as a means to enhance the quality of life for the person with dementia and their caregivers [16,18].

There are a number of studies exploring the therapeutic efficacy of non-pharmacological interventions to address or minimize the presence of maladaptive behaviors. Non-pharmacologic interventions have stemmed from a variety of disciplines in an attempt to positively influence cognition, mood, occupational performance, and a variety of behavioral and psychological symptoms of dementia [16]. These interventions include, but are not limited to, occupational therapy, reminiscence therapy, and validation therapy [16,19].

Occupational therapy interventions can help reduce maladaptive behaviors as occupational therapists (OTs) are skilled at effectively addressing complex behavioral challenges that can occur with dementia [20]. Reminiscence therapy is a non-pharmacological intervention that encourages individuals with dementia to focus their memories on positive experiences [16]. There is moderate evidence to indicate that reminiscence therapy contributes to positive affect and reduces depression [21]. Validation therapy is also commonly used for increasing positive affect for individuals with dementia [16]. Validation therapy aims to validate the perceived reality of that individual in the way they are experiencing that moment or emotion; However, there is mixed evidence regarding support for this therapy [21].

## Therapeutic and Meaningful Activities to Reduce Occupational Dysfunction and Deprivation

For individuals living with Alzheimer's disease, engaging in therapeutic activities can enhance a variety of outcomes that contribute to supporting overall well-being and quality of life [22]. For example, activities for adults with dementia often include music therapy, validation therapy, pet therapy, exercise, cognitively stimulating activities, engagement in meaningful leisure activities, and involvement in basic activities of daily living [21]. Engagement in these therapeutic activities has positively impacted the individual's physical, cognitive, emotional, and social health and well-being [23]. Furthermore, engagement in these types of therapeutic activities has been correlated with reduced symptoms of depression, anxiety, sleep disturbances, agitation, and aggression towards others [21]. Additionally, engagement in therapeutic activities has also been linked to improved involvement in the community and performance at home [24].

Occupational therapists have a unique and valuable skill set for enabling participation, regardless of physical and/or cognitive challenges, through modification of daily activities. The provision of individualized, meaningful activities has been correlated with enhanced quality of life and decreased maladaptive behaviors as they typically foster engagement in one's interests, boost social interaction, and enable positive self-expression, self-determination, and self-efficacy [25,26]. In contrast, lack of meaningful activity for individuals living with dementia is often cited as one of the most persistent and critical unmet needs [27,28].

A current problem within the aging population is related to the concept of occupational dysfunction [3,5]. This often leads to social isolation, occupational imbalance, and occupational deprivation due to the lack of opportunities to engage in one's preferred and/or meaningful activities [5]. Within dementia care facilities, occupational deprivation can occur if group activities are offered without considering individual and overall group preferences for activities [5]. Therefore, it is important that adult day care centers assess individual interests and ensure that their program offerings address the individual interests and the specific needs of those attending adult day care centers.

## Motion-Based Activities Accommodating Preferences

There is growing evidence to support the therapeutic use

of motion-based activities, defined as the utilization of movement of the body that is replicated into virtual gaming systems, for adults with dementia [29,30]. For example, the use of touch screens has been associated with improved social interaction, positive attitudes, as well as enhanced participation and overall well-being [29,31]. Additionally, the evidence suggests that motion-based technological devices can provide an avenue for cognitive stimulation, physical activity, and enhancing engagement in leisure activities quality of life [30]. Moreover, Dove & Astell [31] asserted that engagement in motion-based activities has the capacity to support multidimensional well-being for individuals living with dementia. Whereas Bruil et al. [29] provided evidence to suggest that virtual reality and cognitive-based games have yielded beneficial outcomes on mood, staff-patient interaction, cognition, memory, and overall quality of life [30]. Furthermore, engagement in the Magic Table and Wii game motion-based activities have also been correlated with enhancing social skills, social connections, and having the potential to increase positive affect and reduce agitation and maladaptive behaviors [30,31].

Currently, there is emerging and building evidence to support the use of the Magic Table for individuals living with dementia. The Magic Table is a technological system that can project approximately 140 different motion-activated games onto a surface [32]. Evidence suggests that engaging in therapeutic activities at adult day care facilities, such as the Magic Table, can lead to improvements in executive functioning, memory, and cognition [33]. More specifically, Bruil et al. [29] asserted that the increased interaction with the Magic Table is related to a higher likelihood of improvements in cognitive skills and physical behavior. Additionally, Bruil et al. [29] provided evidence that engagement in Magic Table activities can also bring about increased positive affect and improved caregiver relationships. Likewise, the current literature suggests that engagement in Wii games (Wii Sports, Wii Sports Resort, and Wii Just Dance), another interactive motion-based gaming system, have similar benefits as the Magic Table. For example, Dove and Astell [30] provided evidence which suggested that engagement in Wii activities has the potential to increase one's cognitive and physical skills (e.g., gait, balance, attention, and memory) leading to improved quality of life. In addition, Jahouh et al. [33] determined the use of Wii had a significant positive impact on improving cognition, such as executive functioning, and a decrease in maladaptive behaviors and improvement in everyday activities.

Thus, the purpose of this study was to investigate whether engaging in self-selected motion-based games would result in higher indicators of engagement and/or improved positive emotional behaviors in older adults with mild to moderate dementia. More specifically, the researchers explored if older adults with mild to moderate dementia who engaged in self-selected motion-based Wii games and/or engaged in self-selected motion-based Magic Table games would demonstrate higher indicators of engagement and/or improved positive emotional behaviors compared to older adults with mild to moderate dementia who engaged in activities typically provided at an adult day center.

## METHODS

### Description of Research Site: Community Adult Day Center, Downers Grove, Illinois

Community Adult Day Center (CADC) is a non-profit organization located in Downers Grove, Illinois. It was established in 1986 by an occupational therapist who believed in the importance of caring for the whole person: their mind, body, and spirit [8]. CADC provides services for adults with dementia who are no longer safe or happy being home alone during the day. The premise for services offered at the CADC is based on the principle that seniors are happiest when involved in purposeful activities that allow them to be proactive members of the community. For example, the CADC provides opportunities for adults with dementia to find companionship and to enhance overall quality of life (QoL) by facilitating engagement in daily activities and leisure interests that stimulate the mind, body, and spirit. For instance, attendees at CADC may engage in activities such as: (1) various types of puzzles, games, craft activities, and trivia to help stimulate their mind; (2) various forms of exercise such as gardening, playing in a rhythm band, or playing table hockey to help keep the physical body healthy; and (3) various activities such as chair yoga, meditation, pet therapy, singing, and a variety of spiritual events to help engage and address one's spiritual needs. In summary, CADC strives to provide services to help individuals, their family members, and/or caregivers navigate through the journey of a dementia diagnosis. Additionally, since activities typically offered at CADC tend to occur in large groups, this can limit the ability for individuals to self-select activities that may be individually

meaningful to them. Gaming systems such as Wii and the Magic Table offer a plethora of games within each system. This inherently affords more choices and may increase one's ability to participate in activities that may be more meaningful and purposeful to the person.

### Research Design and Intervention

This randomized exploratory control study utilized a quasi-crossover design. A quasi design refers to the inability to adhere to true experimental procedures due to ethical or feasibility logistics [34] and a crossover design allows the participants to receive multiple interventions in two different sequences [35]. This approach was chosen due to the inability to control attendance at CADC [35].

### Study Participants and Recruitment

This study included a total of 33 older adult participants with mild to moderate dementia who attended the Community Adult Day Center (CADC) located in Downers Grove, Illinois. Attendees in this study ranged in age from 62 to 99 years old. All individuals who attended CADC were eligible to participate in this study if they were able to speak English and have been diagnosed with mild-moderate dementia. Participants were recruited with convenience sampling methods due to limited ability to use more probability-based recruitment methods and unpredictable attendance of study participants for experimental interventions [36]. Written informed consent and assent was gathered before the collection of any data. The director and staff at CADC assisted with the recruitment process and the principal investigator was available via telephone, email, and/or in-person to answer any and all questions from the participants, family, caregiver, and/or legal power of attorney.

The participants in this study comprised of 10 individuals in the experimental group and 23 individuals in the control group. The participants that were present initially on the first day of data collection were randomly assigned to the control group or experimental group. Participants who joined at various points during the intervention after the experimental groups were assigned were automatically added to the control group because of the need to run the Wii and Magic Table games in a small group.

## Research Instruments

### ***Assessment of Quality of Activities, an Observation Tool (A-QOA)***

The Assessment of Quality of Activities (A-QOA) is an observational tool to evaluate the strength of a person's engagement in an activity [37] (Appendix A). The A-QOA is a client-centered assessment tool that evaluates the quality, meaningfulness of activities, and tasks from the observer's perspective [38]. This measurement is based on multiple factors, including the state of engaging in an activity, verbal and emotional expression, social interaction, and the effect on the person performing the activity [38]. The A-QOA consists of 21 items and each item is scored on a 4-point scale based on the frequency and intensity of each observed item (1 = *Subject item is not observed*; 2 = *Subject item observed but to a limited degree/questionable level*; 3 = *Subject item is observed*; and 4 = *Subject item observed very strongly/exceptionally strongly*) [38]. Research on the A-QOA has demonstrated internal scale validity and item reliability. Item separation reliability was found to be 0.99 and person separation reliability was found to be 0.94 [37]. In addition to collecting the quantitative data from the A-QOA, the researchers also collected a record of the participants' statements related to their thoughts, feelings, and experiences related to the motion-based activities. The researchers' field notes represented direct quotes from the participants which were expressed during and immediately following their engagement in the motion-based activities. This qualitative data was analyzed for common themes.

### ***Researcher-Developed Questionnaires***

Two different researcher-developed questionnaires were developed as a means to gather additional information from the staff and caregivers. This was conducted at the end of the study for both the staff and caregivers. The researcher-developed questionnaire administered to staff was an 11-item questionnaire with 10 closed-ended questions and 1 open-ended question (Appendix B). This questionnaire provided additional data regarding the amount of socialization they witnessed from participants while at the day center, whether or not they enjoyed the regularly scheduled activities provided at the day center and if they noticed any changes in behavior after engagement with the Magic Table or Wii games. The researcher-developed questionnaire that was administered to the caregiver was a 10-item questionnaire with 9 closed-ended questions and 1 open-ended question (Appendix C). In

this questionnaire, the closed-ended questions consisted of 6 questions with responses that included "never", "sometimes", "often", and "very often" regarding observable positive and negative affect behaviors. These were followed by two yes-no questions related to sleep and positive mood changes. It was concluded with one rating scale that measured change in observed mood from 1 being "no change" and 10 being "a lot of change". There was one opportunity for an open-ended response for the caregiver to indicate why they responded with the rating they did for the last item on this questionnaire. This caregiver questionnaire was developed to investigate if there was a potential residual effect of therapy activities that benefit the individual when they return home from day care.

### **Procedures for Data Collection**

The university's institutional review board approved this research study. Prior to data collection, in order to establish inter-rater reliability, the researchers in this study observed many of the clients at CADC participate in numerous activities and then filled out the A-QOA for each observation. The researchers established 96% agreeability on the A-QOA scores before data was collected. During data collection, the researchers in this study filled out the A-QOA for each participant at the end of each session, regardless of if the participant was in the control or intervention group. The two different researcher-developed questionnaires were filled out by the family/caregiver/legal power of attorney and staff at the end of the study for the participants.

Data collection and interventions were done over a 10-week period of time. All sessions for the control and experimental group lasted approximately 2 hours for each day of data collection. The control group participated in the regularly scheduled activities offered at CADC over a 10-week period of time. These activities consisted of a variety of activities and games with either a gross motor, cognitive, or fine motor focus. The CADC staff and principal investigator ran the everyday activities offered to the control groups. The A-QOA was scored for each participant every week during the regularly scheduled activities offered at the CADC during the ten-week period. The experimental group participants were randomly allocated to receive treatment for either the self-selected Wii games in the first hour of the first 5 weeks or the Magic Table for the first hour of the first 5 weeks. After approximately one hour of engagement in the Wii/Magic Table activities, the participants in the experimental group switched to the other motion-

based activity and engaged in that activity for approximately one hour. For the self-selected Wii games, the experimental group chose to participate in one or more of the following Wii games: *Wii Sports*, *Wii Sports Resort*, and/or *Just Dance*. For the Magic Table, participants were offered and chose to participate in a variety of games categorized under the “early to middle stage” activities. The researchers scored the A-QOA for each participant throughout the participants’ engagement in the motion-based activity game (Wii or Magic Table) and/or immediately after. The researchers facilitated running both experimental groups.

**Data Analysis**

Data was stratified by comparison groups (Control vs Magic Table; Control vs Wii; Wii vs Magic Table). The median and interquartile ranges (IQR) for both the total summed score as well as the individual component scores were reported. Mann-Whitney U tests with Benjamini and Hochberg’s adjustment for multiple comparisons were used to compare median scores across strata. P-values for each A-QOA component score and summed scores were compared. Statistical significance was established at .05. Higher scores on the A-QOA represent more engagement in the activity [38]. Researchers rated participants’

responsiveness with the A-QOA on a 4-point scale ranging from “*item is not observed*” to “*observed strong or exceptional tendency*”. Descriptive statistics, in the form of percentages for each question response, were used to describe the results of each questionnaire item.

**RESULTS**

The results section is divided into five sections. That is, the researchers will discuss the difference in the A-QOA scores between the Control vs Magic Table, Control vs Wii, and Magic Table vs Wii. The findings from the CADC staff survey and caregiver survey are also presented.

**Difference in A-QOA scores for Control Group and Magic Table Group**

Data from a total of 33 participants were included in A-QOA analysis. The control group had a median total summed score of 46.7 (IQR: 40.0 - 53.8) which was significantly less ( $p < 0.001$ ) than the Magic Table group which had a median total summed score of 69.5 (IQR: 63.5 - 73.3). The Magic Table group had significantly higher median scores for all individual components except for Focus ( $p = 0.07$ ), Mastery ( $p = 0.13$ ), Choice ( $p = 0.32$ ), and Inventiveness ( $p = 0.83$ ) (Table 1).

**Table 1:** A-QOA Score Comparison Between Control and Magic Table (n = 33)

	Control (n = 23)	Magic Table (n = 10)	p-value <sup>a</sup>
<b>Total Summed Score<sup>b</sup>, median (IQR)</b>	46.7 (40.0 – 53.8)	69.5 (63.5 – 73.3)	<0.001*
<b>Individual Components Score<sup>b</sup>, median (IQR)</b>			
Initiation	3.0 (2.5 – 3.3)	3.8 (3.6 – 4.0)	0.004*
Gaze	3.3 (2.5 – 3.6)	3.9 (3.9 – 4.0)	0.009*
Position	3.0 (2.0 – 3.3)	4.0 (3.9 – 4.0)	0.001*
Continuation	3.0 (2.5 – 3.6)	3.8 (3.2 – 4.0)	0.04*
Focus	3.0 (2.5 – 3.6)	3.7 (3.3 – 3.9)	0.07
Mastery	2.7 (2.0 – 3.0)	2.9 (2.7 – 3.5)	0.13
Choice	2.5 (1.7 – 2.8)	2.2 (1.7 – 2.3)	0.32
Inventiveness	1.5 (1.0 – 1.8)	1.3 (1.2 – 1.9)	0.83
Satisfaction	2.9 (2.0 – 3.0)	3.5 (3.1 – 3.6)	0.004*
Competence	2.7 (2.0 – 3.0)	3.4 (3.0 – 3.8)	0.006*
Willingness	3.3 (2.5 – 3.5)	3.9 (3.8 – 4.0)	0.003*
Smiling	2.5 (2.0 – 2.8)	3.4 (3.3 – 3.6)	0.002*
Animation	2.5 (1.7 – 2.8)	3.4 (3.1 – 3.5)	0.001*
Interaction	2.0 (1.4 – 2.5)	3.8 (3.4 – 3.8)	<0.001*
Cooperation	2.3 (2.0 – 2.5)	3.6 (3.2 – 3.8)	<0.001*
Instruction	1.0 (1.0 – 1.0)	1.8 (1.4 – 1.92)	<0.001*

Communication	1.5 (1.0 – 2.0)	3.7 (3.4 – 3.9)	<0.001*
Caring	1.2 (1.0 – 1.5)	3.2 (3.1 – 3.4)	<0.001*
Sharing	1.2 (1.0 – 1.5)	3.5 (3.3 – 3.7)	<0.001*
Verbalization	1.5 (1.0 – 2.0)	3.8 (3.6 – 3.9)	<0.001*
Reminiscence	1.0 (1.0 – 1.0)	3.2 (2.5 – 3.4)	<0.001*

\*Indicates statistically significant difference

<sup>a</sup>Mann-Whitney U test with Benjamini and Hochberg adjustment for multiple comparisons

<sup>b</sup>Scale: 1 – item is not observed, 2 – item is observed but to a limited degree or questionable level, 3 – item is observed, 4 – observed strong or exceptional tendency

**Difference in A-QOA scores for Control and Wii Group**

The Wii cohort had a median total summed score of 72.3 (IQR: 58.9 - 77.0) which was also significantly higher (p=0.005) when

compared to the control group. The Wii group had significantly higher median scores for all individual components except for Initiation (p=0.06), Continuation (p=0.13), and Mastery (p=0.21) (Table 2).

**Table 2:** A-QOA Score Comparison Between Control and Wii (n = 33)

	Control (n = 23)	Wii (n = 10)	p-value <sup>a</sup>
<b>Total Summed Score<sup>b</sup>, median (IQR)</b>	46.7 (40.0 – 53.8)	72.3 (58.9 – 77.0)	0.005*
<b>Individual Components Score<sup>b</sup>, median (IQR)</b>			
Initiation	3.0 (2.5 – 3.3)	3.6 (3.1 – 3.9)	0.06
Gaze	3.3 (2.5 – 3.6)	3.9 (3.6 – 4.0)	0.02*
Position	3.0 (2.0 – 3.3)	4.0 (3.5 – 4.0)	0.005*
Continuation	3.0 (2.5 – 3.6)	3.7 (3.0 – 4.0)	0.13
Focus	3.0 (2.5 – 3.6)	3.9 (3.5 – 4.0)	0.04*
Mastery	2.7 (2.0 – 3.0)	3.3 (2.1 – 3.7)	0.21
Choice	2.5 (1.7 – 2.8)	3.3 (3.0 – 3.7)	0.007*
Inventiveness	1.5 (1.0 – 1.8)	2.4 (1.6 – 2.9)	0.02*
Satisfaction	2.9 (2.0 – 3.0)	3.7 (3.2 – 3.8)	0.007*
Competence	2.7 (2.0 – 3.0)	3.4 (2.9 – 3.8)	0.03*
Willingness	3.3 (2.5 – 3.5)	3.7 (3.4 – 4.0)	0.03*
Smiling	2.5 (2.0 – 2.8)	3.7 (3.4 – 3.9)	0.002*
Animation	2.5 (1.7 – 2.8)	3.6 (3.2 – 3.7)	0.002*
Interaction	2.0 (1.4 – 2.5)	3.6 (3.0 – 3.9)	0.003*
Cooperation	2.3 (2.0 – 2.5)	3.6 (2.8 – 3.8)	0.01*
Instruction	1.0 (1.0 – 1.0)	1.6 (1.4 – 1.8)	0.001*
Communication	1.5 (1.0 – 2.0)	3.8 (3.1 – 3.9)	0.002*
Caring	1.2 (1.0 – 1.5)	3.5 (2.7 – 3.8)	0.001*
Sharing	1.2 (1.0 – 1.5)	3.6 (2.2 – 3.8)	0.002*
Verbalization	1.5 (1.0 – 2.0)	3.7 (3.2 – 3.9)	0.002*
Reminiscence	1.0 (1.0 – 1.0)	2.9 (2.2 – 3.4)	0.001*

\*Indicates statistically significant difference

<sup>a</sup>Mann-Whitney U test with Benjamini and Hochberg adjustment for multiple comparisons

<sup>b</sup>Scale: 1 – item is not observed, 2 – item is observed but to a limited degree or questionable level, 3 – item is observed, 4 – observed strong or exceptional tendency

**Difference in A-QOA scores for Magic Table and Wii Group**

The Magic Table and Wii demonstrated equally therapeutic levels of engagement within the same cohort of participants.

There were no significant differences between Magic Table and Wii in 20/21 items. There was one significant difference in the measure of choice (p=0.04). For Magic Table the individual component median score was 2.2 and for Wii 3.3 (Table 3).

**Table 3:** A-QOA Score Comparison Between Magic Table and Wii (n = 10)

	Magic Table (n = 10)	Wii (n = 10)	p-value <sup>a</sup>
<b>Total Summed Score<sup>b</sup>, median (IQR)</b>	69.5 (63.5 – 73.3)	72.3 (58.9 – 77.0)	1.00
<b>Individual Components Score<sup>b</sup>, median (IQR)</b>			
Initiation	3.8 (3.6 – 4.0)	3.6 (3.1 – 3.9)	0.30
Gaze	3.9 (3.9 – 4.0)	3.9 (3.6 – 4.0)	0.69
Position	4.0 (3.9 – 4.0)	4.0 (3.5 – 4.0)	0.69
Continuation	3.8 (3.2 – 4.0)	3.7 (3.0 – 4.0)	0.89
Focus	3.7 (3.3 – 3.9)	3.9 (3.5 – 4.0)	0.88
Mastery	2.9 (2.7 – 3.5)	3.3 (2.1 – 3.7)	0.77
Choice	2.2 (1.7 – 2.3)	3.3 (3.0 – 3.7)	0.04*
Inventiveness	1.3 (1.2 – 1.9)	2.4 (1.6 – 2.9)	0.09
Satisfaction	3.5 (3.1 – 3.6)	3.7 (3.2 – 3.8)	0.89
Competence	3.4 (3.0 – 3.8)	3.4 (2.9 – 3.8)	1.00
Willingness	3.9 (3.8 – 4.0)	3.7 (3.4 – 4.0)	0.69
Smiling	3.4 (3.3 – 3.6)	3.7 (3.4 – 3.9)	0.68
Animation	3.4 (3.1 – 3.5)	3.6 (3.2 – 3.7)	0.69
Interaction	3.8 (3.4 – 3.8)	3.6 (3.0 – 3.9)	0.68
Cooperation	3.6 (3.2 – 3.8)	3.6 (2.8 – 3.8)	0.82
Instruction	1.8 (1.4 – 1.92)	1.6 (1.4 – 1.8)	0.89
Communication	3.7 (3.4 – 3.9)	3.8 (3.1 – 3.9)	0.77
Caring	3.2 (3.1 – 3.4)	3.5 (2.7 – 3.8)	0.93
Sharing	3.5 (3.3 – 3.7)	3.6 (2.2 – 3.8)	0.69
Verbalization	3.8 (3.6 – 3.9)	3.7 (3.2 – 3.9)	0.30
Reminiscence	3.2 (2.5 – 3.4)	2.9 (2.2 – 3.4)	0.69

\*Indicates statistically significant difference

<sup>a</sup>Wilcoxon Signed-Rank test with Benjamini and Hochberg adjustment for multiple comparisons

<sup>b</sup>Scale: 1 – item is not observed, 2 – item is observed but to a limited degree or questionable level, 3 – item is observed, 4 – observed strong or exceptional tendency

**Qualitative Findings**

Thematic analysis of the qualitative findings from the researchers’ field notes revealed that the participants’ statements fell into five different categories/themes: (1) Reminiscence; (2) Caring; (3) Instruction; (4) Communication; and (5) Choice. Appendix D represents the participants’ quotes related to each theme.

**Researcher-Developed Questionnaires**

**Findings from the Community Adult Day Center Staff Survey**

One CADC staff member filled out the researcher-developed staff survey. This survey had a 48% response rate (i.e., it was filled out for 48% of the participants in this study). This data represented 90% of the experimental group and 30% of the

control group participants. In response to the open-ended question inquiring whether or not there were any noticeable changes in behavior after the participants engaged the Wii and Magic Table activities, the staff member repeatedly expressed that clients were “more energetic and social after activities.” Appendix E depicts the staff’s responses to the questions on the staff survey.

### **Findings from the Community Adult Day Center Caregiver Survey**

Seven caregivers filled out the researcher-developed questionnaire for the caregivers, leading to a 21% response rate. This data represented 5 (50%) of the participants in the experimental group (motion-based games). From the caregiver survey data, 71.42% of the caregivers indicated that the participant slept better after participating in day care and 100% of the caregivers noticed a positive change of mood after the participant attended day care. When asked to rate a positive change in mood on a 10-point scale (1 = *no change*; 10 = *a lot of change*), the mean score was 7.57. Appendix F depicts the caregivers’ responses to the questions on the caregiver survey. Open ended comments on the survey included the following: The participants appear “happier with more social engagement” and “mood is really good after the senior center; they are more content and less restless”.

## **DISCUSSION**

The purpose of this study was to investigate whether engaging in self-selected motion-based games would result in higher indicators of engagement and positive emotional behavior in older adults with mild to moderate dementia. The findings of this current study are consistent with previous findings that engagement in meaningful activities are correlated with enhanced active engagement, socialization, and positive mood [25,26]. More specifically, the researchers in this study found that the self-selected motion activities had higher levels of active participation when compared to the individuals who engaged in regularly scheduled activities (e.g., bag toss, chair yoga, photo stories, etc.), as the total summed scores for both motion-based activities (Wii and Magic Table) were both significantly higher than summed scores for the control group.

Moreover, 17 out of 21 of the A-QOA component scores for the Magic Table were statistically significant, with 8 of the items with a p-value less than 0.001 (e.g., interaction, cooperation, communication, instruction, caring, sharing, verbalization, and

reminiscence) and 9 of the items with a statistical significance that ranged from 0.04 - 0.001 (initiation, gaze, continuation, satisfaction, competence, willingness, position, animation, and smiling). These findings also support the current evidence which suggests that engagement in meaningful activities is correlated with enhanced active engagement, socialization, and positive mood [25,26]. One explanation for this finding may be related to the fact that the participants had choice regarding which game they wanted to play, or, since the Magic Table activity is situated so that every participant is facing each other around a table and in close proximity to one another, it is possible that these games inherently foster enhanced interactions. Another possible explanation for the this finding may be related to the possibility that the physical use of a touch screen and the games contained within the Magic Table platform foster increased participation due to its inherent properties related to engagement and socialization [29,31].

Similarly, the Wii group had 18 out of 21 A-QOA component scores that were statistically significant, with 3 of the items with a p-value less than 0.001 (instruction, caring, and reminiscence) and 15 of them with a statistical significance that ranged from 0.043 - 0.001 (gaze, position, focus, choice, inventiveness, satisfaction, competence, willingness, smiling, animation, interaction, cooperation, communication, sharing, and verbalization). It is possible that some of the differences between the Wii scores and the Magic Table scores may be related to the fact that many of the Wii sporting games necessitated that the participants take individual turns while the rest of the group watched. However, when the participants were watching a person participate in the sport activity, it was not uncommon for the observers to provide encouragement and/or instructions regarding how the player could position themselves and use the equipment better to improve their performance in the self-selected Wii game. This finding coincides with a study by Jahouh et al. [33] which revealed that participation in Wii activities improved cognition and executive functioning skills that were necessary for providing instruction to others. The researchers of this study also noted that the participants demonstrated caring as they would often encourage others when they were playing a game and they mimicked others’ emotional reactions during this activity. Furthermore, the researchers made particular note that the Wii games also fostered reminiscing as the participants commonly discussed various moments when they engaged in certain sports or discussed how old they were when certain

music choices initially came on during the Wii dance games. Additionally, one should note that the participants who engaged in the motion-based activities (Magic Table and Wii games) were consistently in small groups which consisted of a maximum of 5 total participants at one given time. Given that the maximum number of participants was 5, the group size alone could have facilitated interactions which may have innately enhanced communication, verbalization, cooperation, caring, sharing, reminiscing, and instructing others in the group.

The results of this study add to the existing and building literature which illustrates the many benefits of non-pharmacological interventions [16]. Interestingly, the qualitative findings from the researchers' field notes reflected themes which represented some of the most statistically significant items on the A-QOA (reminiscence, caring, instruction, communication, and choice) and seem to support the current evidence suggesting that engaging in therapeutic motion-based activities has the potential to enhance mood and positive emotional responses and decrease maladaptive behaviors [23,25,26]. Due to the similarity in the statistical findings for both motion-based games, the researchers of this study concluded that both motion-based games seem to be equally therapeutic and have the potential to enhance engagement and positive behaviors for older adults with dementia.

Reminiscence was an item on the A-QOA which was statistically significant for both motion-based activities (Magic Table and Wii games) and emerged as a major theme after reviewing field notes from the participants' statements. Since there is moderate evidence to suggest that reminiscence therapy decreases symptoms of depression and anxiety in adults with a mild-moderate dementia diagnosis [21], adult day care centers and practitioners working with individuals with dementia may want to consider the therapeutic use of combining both motion-based activities with intentional efforts to foster reminiscing. Additionally, since the experimental group participants were able to choose which therapeutic activity they wanted to engage in, it enabled and fostered opportunities for choice and engagement in personally meaningful activities which have also been correlated with enhanced quality of life, decreased maladaptive behaviors, enhanced social interactions, self-determination, and self-efficacy, as well as positive forms of self-expression [25,26].

In summary, the findings of this study support the current and building evidence suggesting that engagement in meaningful and motion-based activities is correlated with enhanced active engagement and positive forms of mood and behaviors. The results of this study also seem to suggest that both forms of motion-based activities (the Magic Table and Wii games) have relatively equal therapeutic value and potential to increase engagement and positive behavior in older adults with mild to moderate dementia.

### Limitations

Even though this study revealed statistically significant findings, one needs to consider several of the limitations related to this study. First, and foremost, this study included a small sample size ( $n=33$ ). Additionally, due to inconsistencies with attendance, participants joining the study after the initial day of data collection, and due to the logistics of the experimental activities (limited number of participants that could engage in the Magic Table and Wii games at any given time), participants who joined after the initial day of data collection, were added to the control group which resulted in an unequal number of participants representing the experimental ( $n=10$ ) and control groups ( $n=23$ ). Also, since this study used convenience sampling from one local adult day care center to recruit participants, one cannot generalize these findings. Lastly, due to a myriad of factors such as inconsistent attendance, illnesses, vacations, time constraints, etc., times for data collection were not always consistent in terms of the day of the week or the time of day (i.e., the researchers conducted six sessions in the morning and four sessions in the afternoon due to scheduling restraints). Thus, these factors could have impacted on the results and/or affected the level of alertness and/or energy of the participants and sometimes resulted in a participant not being present on a data collection day.

Furthermore, environmental factors could have also impacted the results. For instance, the room in which the Magic Table was located was often found to be uncomfortably cold and resulted in participants wanting to be wrapped in blankets. Thus, there were times that the participants stopped engaging in the motion-based game, which impacted the scoring and ultimately the results. It was also noted that the Magic Table room was darker than the Wii room, which could have increased drowsiness and impacted on engagement, scores, and/or results. Lastly, in terms of the researcher-developed surveys, one needs to consider that there was a low response rate for

both the staff and caregiver surveys. Additionally, one needs to keep in mind that only one staff member was available to complete the forms for the participants, and this staff member seemed to only fill out the form for the participants who were present on the last day of data collection. Finally, since individuals with dementia have cognitive limitations, this fact alone could have influenced scores on A-QOA and, perhaps, might explain why some of the items (mastery, initiation, and continuation) were not statistically significant for both the control and experimental groups.

### Future Directions

Due to the numerous limitations of this study, further research is necessary in order to generalize these findings. More specifically, the researchers recommend similar studies with a larger sample size, equal representation among the experimental and control groups, consistent days and times for data collection, and studies which represent the population at large versus one adult day care center. A potential future direction based on the findings from this study, as well as previous studies, is that adult day centers could explore the use of motion-based technologies to address the individual and groups' needs and interests related to their leisure pursuits and other occupations. Additionally, researchers could benefit from exploring the use of the A-QOA to measure engagement across other areas of occupation aside from leisure participation due to the established reliability and validity of the tool when assessing this population.

### Implications for Practice in Occupational Therapy

This study has implications for occupational therapy practice because it suggests and helps support the current evidence that motion-based technologies can have a myriad of therapeutic outcomes for individuals with dementia. It also highlights and supports the current evidence indicating that providing choice in one's daily life can increase their engagement and has the potential to increase positive mood, behaviors, and quality of life. Since occupational therapists embrace the uniqueness and holistic view of individuals, occupational therapists could be a valuable member of the interdisciplinary team at adult day care centers, as they have the knowledge and skills necessary to facilitate participation in one's meaningful activities and occupations.

### CONCLUSION

The results of this study seem to suggest that engaging in self-selected motion-based games has the potential to enhance engagement and improve positive emotional behaviors in older adults with mild to moderate dementia. This could ultimately lead to them having more meaningful and fulfilling days and improved quality of life. The experimental participants in this study were able to self-select which games/activities they wanted to engage in which helped ensure that the participants were engrossed in activities and games which were personally meaningful to them. It appears that both of these factors enhanced engagement, as well as many other positive behaviors (e.g., caring, focus, choice, inventiveness, satisfaction, competence, willingness, smiling, animation, interaction, cooperation, communication, sharing, verbalization, and reminiscing). The findings from this study also seem to suggest that both the Magic Table and Wii games are both therapeutic motion-based activities for individuals with mild to moderate dementia.

### CLINICAL TRIAL REGISTRATION

This Study was registered with Clinical Trials.gov (NCT07209124).

### DISCLOSURE STATEMENT

The authors of this article have no competing interests.

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**Appendix A:** The Assessment of Quality of Activities (A-QOA)

Items	Explanations
1. Initiation	Initiating the activity
2. Gaze	Directing one's gaze at the activity
3. Position	Positioning one's body toward the activity
4. Continuation	Continuing the activity
5. Focus	Concentrating on the activity
6. Mastery	Demonstrating activity-related knowledge and techniques
7. Choice	Making selections /showing preferences during the activity
8. Inventiveness	Working out a way to make the activity progress smoothly
9. Satisfaction	Expressing satisfaction as a result of the activity
10. Competence	Expressing a sense of capability
11. Wilingness	Showing willingness toward the next activity
12. Smiling	Showing a smile
13. Animation	Showing excitement
14. Interaction	Interacting with others through the activity
15. Cooperation	Cooperating with others in the activity
16. Instruction	Sharing activity-related knowledge and techniques with others
17. Communication	Conveying one's intention to others
18. Caring	Considering to others
19. Sharing	Sharing activity-induced emotions with others
20. Verbalizing	Increasing utterance
21. Reminiscence	Reminiscing

**Rating Scale:**

4 = "observed strong or exceptional tendency"

3 = item is "observed"

2 = item is observed but to a limited degree or questionable level

1 = item is "not observed"

**Appendix B: Researcher Developed Questionnaire - CADC Staff****Researcher-Based Questionnaire: CADC Staff**

In a typical week, how often does (client) express feelings of joy, happiness, and/or positive mood?

**Never**                      **Sometimes**                      **Often**                      **Very often**

In a typical week, how often does (client) appear to be content/satisfied?

**Never**                      **Sometimes**                      **Often**                      **Very often**

In a typical week, how often does (client) have negative comments/verbal responses?

**Never**                      **Sometimes**                      **Often**                      **Very often**

In a typical week, how often does (client) express frustration or restlessness in a non-verbal manner?

**Never**                      **Sometimes**                      **Often**                      **Very often**

During a typical week, how often does (client) engage in activities?

**Never**                      **Sometimes**                      **Often**                      **Very often**

During a typical week, how often does (client) seem relaxed and/or socially engaged?

**Never**                      **Sometimes**                      **Often**                      **Very often**

In a typical week, how often does (client) socialize with other participants at CADC?

**Never**                      **Sometimes**                      **Often**                      **Very often**

In general, do you feel (client) enjoys being at day-care?

**Never**                      **Sometimes**                      **Often**                      **Very often**

How often do you feel (client) enjoys the activities at CADC?

**Never**                      **Sometimes**                      **Often**                      **Very often**

If the client engaged in the Magic Table or Wii Games, did you notice any change in their behaviour?

**Never**                      **Sometimes**                      **Often**                      **Very often**

If the client engaged in the Magic Table or Wii Games, did you notice any change in their behaviour?

**Yes**      **No**

**If yes, please explain:**

**Appendix C: Researcher Developed Questionnaire - Family, Caregiver, and/or Legal Power of Attorney**

**Researcher-Based Questionnaire: Caregivers**

In a typical week, how often does your loved one express feelings of joy, happiness, and/or positive mood?

**Never                      Sometimes                      Often                      Very often**

In a typical week, how often does your loved one appear to be content/satisfied?

**Never                      Sometimes                      Often                      Very often**

In a typical week, how often does your loved one have negative comments/verbal responses?

**Never                      Sometimes                      Often                      Very often**

In a typical week, how often does your loved one express frustration or restlessness in a non-verbal manner?

**Never                      Sometimes                      Often                      Very often**

Outside of day care, during a typical week, how often does your loved one engage in activities?

**Never                      Sometimes                      Often                      Very often**

Outside of day care, during a typical week, how often does your loved one seem relaxed and/or socially engaged?

**Never                      Sometimes                      Often                      Very often**

Do you feel that your loved one sleeps better after attending day care at CADC?

**Yes                      No**

Do you notice a positive change in their mood after attending day-care?

**Yes                      No**

If you see a positive change in mood after attending day-care, please rate this change.

**1   2   3   4   5   6   7   8   9   10**

**1-No Change; 10-A Lot of Change**

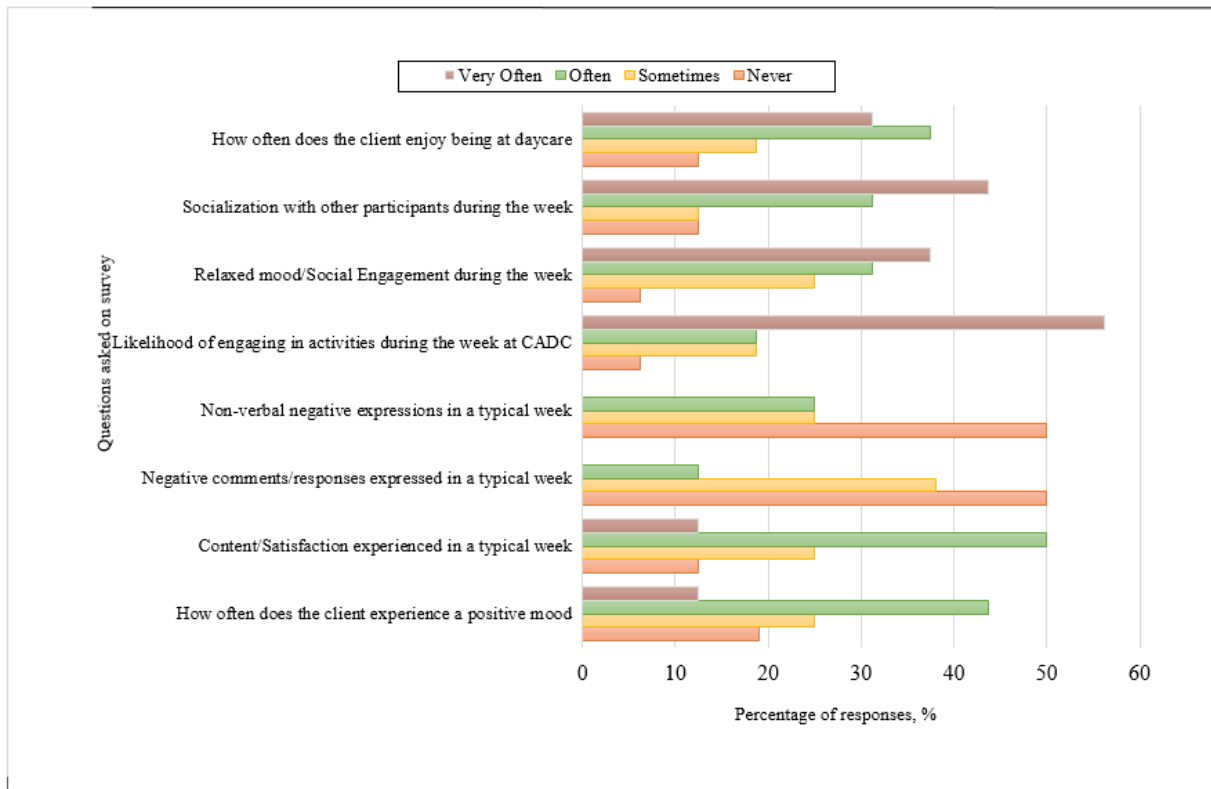
**Please explain:**

**Appendix D: Qualitative Data Collected with A-QOA: Assessment of Quality of Activities**



Prominent qualitative data noted by researchers of participants during data collection and observation in conjunction with elements from the *Assessment of Quality of Activities (A-QOA)*<sup>38,39</sup>. These direct quotes highlight personal memories linked to past events, expressions of support or encouragement, guidance provided during an activity, expressions of self-disclosure, and expressions of preferences.

**Appendix E: Community Adult Day Center Staff Survey Results**



**Appendix F: Community Adult Day Center Caregiver Staff Survey Results**

