COGNITION AND KINESIOLOGY:
A DUAL-STRATEGY APPROACH TO LEARNING DANCE CHOREOGRAPHY

A thesis submitted in partial fulfillment of the requirements
For the degree of Master of Arts in
Psychology

by

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May 2012
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ACKNOWLEDGMENT

I would like to thank my committee members who supported my efforts in writing this thesis.

To my chair, Dr. Scott W. Plunett,

To Dr. Andrew T. Ainsworth,

To Dr. Robert J. Youmans,
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ABSTRACT

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Dancers often have difficulty remembering choreography they learn in a class or workshop. This project investigates strategies dancers can use to effectively learn and remember choreography so that they will be more likely to perform it correctly in the future. The first part of this project introduces and tests the effects of new strategies designed to improve dancers’ abilities to cluster movements and organize events together in ways that might make choreography easier to remember (Hanna, 2008; Stinson, 1985). The second part of this project extends these findings by making some redesign recommendations for the Nintendo Wii’s Just Dance video game. Both goals have the potential to augment usability, increase customer satisfaction, and maximize the potential health benefits related to learning how to dance.
CHAPTER I

INTRODUCTION

According to Kaeppler (1978), the word ‘dance’ can be described as a cultural art form that is a result of creative processes in which the human body moves through space and time. Boas (1944) adds that it is a form of patterned expression performed in a given form that occurs through specifically selected and controlled rhythmic movements. Choreography, on the other hand, includes the ability to create and interpret a particular sequence of dance movements (Giersdorf, 2009). Therefore, for the remainder of this paper, the term choreography will be used specifically to describe a given set of dance movements linked together in a specific order, to be executed at specific times, and pertaining to specific parts of a song or musical composition. Dance can be improvised and simply describes the activity of moving to music, while choreography is not improvised and indicates applying structure, methodology, and meaning to a dance routine (Risner, 2000).

Both professional and amateur dancers often face the problem of having difficulty remembering and later performing choreography they learned in a class or workshop. This process may take extensive amounts of time until a sequence is learned accurately, and takes even longer to memorize the order of the movements so they can be smoothly strung together. Rehearsal, practice, and repetition are critical to maintain the sequence in long-term memory, as well as in muscle memory. However, the process of interest in this study is the one that occurs prior to rehearsal and repetition, and that is the learning process.

Research suggests that information that is poorly encoded in long-term memory
will be less likely to be remembered at a later time (Atkinson & Shiffrin, 1968). Besides frequent physical repetitions for improving motor skills, there are many cognitive processes involved when learning dance combinations or choreography. For example, a dancer must cluster and organize movements into schemas that are related to each other, but he or she must also engage in physical practice to reach a mastery skill level (Stinson, 1985). Other research suggests that the same components of the brain that function for visualization, creativity, and memory are at play during any dance-learning activity (Hanna, 2008). In addition to organization, counting movements to the rhythm of the music is another essential part of learning a dance sequence (Enghauser, 2007) because it provides a logical structure for the sequence of movements and assists with maintaining an accurate tempo of movement execution (Kassing & Jay, 2003). This project investigates these two specific strategies that professional and amateur dancers can use to effectively learn and remember choreography so they will be most likely to successfully perform the choreography in the future.

If the proposed strategies prove to be effective, future research would be warranted in at least two domains. First, the finding would suggest that dual-strategic approaches can be implemented to improve how quickly people can learn to perform physical actions in general, with applications to a variety of training programs. Second, the finding would suggest that the user-interface and training components of games and devices that are targeted to promoting physical movement (e.g., Wii Fit and other exercise games) might be improved via the inclusion of dual-strategic training.
CHAPTER II
REVIEW OF LITERATURE

Organization of New Information

One of the ways that expert dancers decrease the amount of cognitive resources they use to learn a new choreography is by organizing the new information (Chassy & Gobet, 2011). It is known that people remember information better when they store it in chunks as opposed to individual pieces (Gobet et al., 2001; Jeffries, Lambon, & Baddeley, 2004). This concept directly applies to dance. When a dance student is learning new movements, it may be a good and logical idea for them to memorize the dance sequence in two separate chunks (i.e., verses and chorus of a musical composition). Research shows that chunks of information that are presented more frequently are more likely to be recalled (Perlman, Pothos, Edwards, & Tzelgov, 2010). Thus, the chorus should be learned first because it is a part that will repeat several times throughout the routine. The movements in the chorus should be learned separately from the movements that correspond to the verse of a song. Then, a dancer can learn the combinations for the first verse, second verse, and so on, while adding the chorus in between these combinations where appropriate. This way, the person is storing information in two different categories (i.e., chorus and verses). If the musical composition has lyrics, the dancer can also use verbal cues in the song to associate with particular movements (Kassing & Jay, 2003).

Stevens and McKechnie (2005) suggest that there are two types of knowledge that determine whether successful learning of a dance will take place: procedural and
declarative. Procedural knowledge pertains to muscle memory and the physical repetition to master a particular movement or sequence. Declarative knowledge, however, suggests that dancers use their bodies to make (or declare) statements, which correspond to personal experiences. Thus, when students are trying to learn a dance sequence, they can organize it and think about it in a way that makes sense to them, either through associations or episodic memory. By creating these connections between newly learned information and their personal experiences, they are increasing their probability of correctly recalling the dance sequence.

**Counting**

Counting is one of the most important techniques that students, performers, and instructors use (Benari, 1995). When learning a combination, it is important for students to create a structure for which movement comes first, how many times a movement is executed, for how many beats of the music a movement will last, and how fast or slow the movement should be performed (Hatchett & Gitlin, 2000). Assigning a number to each movement that corresponds with the music helps dancers to learn the sequence more thoroughly. Thus, dancers count movements as well as the beats in the music.

Instructors depend on counting as another way of rehearsing the rhythm of a dance, either verbally or silently (Benari, 1995). The counting range will depend on the time signature and beat of the music to which the dance is being performed, but in most cases, the range is from one to eight because that range is thought to be the easiest rhythm to teach and learn (Joosten, 2009; Kassing & Jay, 2003). Again, this relates to the chunking process, and in this case, we suggest that people learn dance combinations that
are taught in groups of eight counts per combination. This does not mean that there must be eight different movements. Instead, it means that the dancer should pay attention to how many times a movement repeats and to the duration for how many counts each movement should be executed.

Kassing and Jay (2003) posit that some educators depend on verbal-cognitive techniques to teach dance, and one of those techniques includes counting. Counts provide students with cues for when to begin and end a movement, as well as to maintain the tempo of the dance. Counting also helps dancers to stay on beat with the rhythm and maintain the correct tempo at which they must dance, a term dancers and musicians call rhythmic correctness (Kassing & Jay, 2003). During a performance, adrenaline may cause the dancer to speed up involuntarily (Walker & Nordin-Bates, 2010), or during long hours of rehearsal it may cause a dancer to move slower than the music requires. Counting may be beneficial in both situations by assisting the dancer to stay focused on the correct timing of the music and execution of movements.

Gilbert (2003) describes the application of Gardner’s theory of multiple intelligences to dance, and explains that a main skill in learning to dance is related to logical-mathematical intelligence, also known as counting (Gardner, 1999). By counting and creating strings of combinations, the dancer begins to form a metaphorical sentence, which links to a larger paragraph, which then leads to an entire story. Dance has many different notations to indicate its own language (Fügedi, 2003), and counting is one of those critical language tools.
Gender and Dance

Research suggests that dance is typically viewed as dominated by females (Ferdun, 1994), and thus limits male participation in this social and physical activity. More current research shows that females also tend to start dancing at an earlier age than men (Bailey & Oberschneider, 1997). However, different historical and social contexts have created a large range of dance genres that can be identified with masculinity. Some of those dance types include hip-hop, modern dance, Brazilian capoeira, and folkloric dances, which historically are performed to represent a man’s power, personality, and masculine role in a society (Rhone, 2010). In partner or couple dances between men and women, such as ballroom dance, salsa, and other Latin dances, the interaction displayed by the movements of the dance may even be provocative and dramatic (Borland, 2009). Other genres of dance such as ballet, contemporary dance, belly dance, and jazz dance tend to be viewed as more feminine (Fisher, 2007).

Working Memory

Working memory capacity is an individual difference among people that may cause some participants to perform better or worse than others on a dance-learning and recall task. According to Baddeley (1986), working memory is a multi-dimensional concept that consists of three main parts: the central executive, the visuospatial sketchpad (i.e., information that is maintained visually), and the phonological loop (i.e., information that is maintained verbally). Working memory may play a predictive role in determining dance performance because dance consists of various dimensions (i.e., physical and cognitive) that activate both visual and auditory receptors in the brain. The visual learning process
occurs when students are watching an instructor and watching themselves in a mirror (which is common in dance classes). The auditory processes involve listening to music, rhythms, and counts. Thus, both loops are activated, and the connection between them is made by the central executive (Baddeley, 1986).

The ability for dancers to simultaneously sense, encode, and recall both visual and auditory information with which they are being presented in a short amount of time is likely to vary from person to person. For this reason, it is possible that participants will differ in their measures of working memory, which, in turn, may possibly affect their learning process and final dance performance.

**The Present Study**

Dance and music video games have become increasingly popular in the past few years. Between 2008 to 2010, three different companies released dance games, including Konami’s Dance Dance Revolution, Harmonix’s Guitar Hero, and Nintendo Wii’s *Just Dance* (Bruno, 2010). The *Just Dance* franchise, in particular, has been especially popular, and Nintendo has produced various volumes of the game. Advertisements for the latest version, titled *Just Dance 3*, describe the product as follows: “In *Just Dance* players learn real dance moves to songs they know and love.” Interestingly, the designers and manufacturers of this product appear to believe that this video game can successfully teach its buyers how to “learn real-life dance moves” they can perform later.

This project is designed to investigate the manufacturer’s claims, and then introduces several professional dance choreography techniques that might improve the quality of the program. The first part of this experiment introduces and tests the effects of
a strategic tutorial, which was created based on findings from previous dance education research. The strategy focuses on two techniques: organization and counting. Each technique is separately defined and presented as a tutorial in a timed slide show. After viewing the slideshow, participants interact with the Just Dance videogame and practice applying the techniques they learned in the slideshow. The score displayed by the video game will be used to objectively measure dance performance based on how correctly they execute movements at a specific time. A post-task memory quiz will be used to assess participants’ memory of the choreography.

It is hypothesized that participants who are exposed to one of the two strategies (i.e., organization or counting) will have higher dance performance scores than the participants who are not exposed to either strategy. More specifically, I predict that the use of these strategies will improve participants’ memory of the dance movements, and that memory gains will directly improve their performance, thus increasing their score on the video game. The strategies are designed to improve memory by reducing the load on dancers’ working memory capacity while learning the dance. According to Becker and Morris (1999), working memory can be explained as a system in the brain that maintains information for immediate processing. In other words, once information is newly encoded, it remains in working memory for several seconds before it is manipulated for further processing, and is lost or forgotten if no further manipulation occurs. Given this definition, information that is held in working memory is at risk of being lost during new dance learning because of the numerous interferences and distractions that may occur during the time that new information is being processed (Nikolić & Singer, 2007).
In the present study, participants who experience the counting strategy will learn to pair numbers with movements, and to link the movements together into combinations. Thus, the participants may have a better chance of strategically storing the sequence of movements in their long-term memory (Becker & Morris, 1999). In addition, because each movement will be linked to a count, this information will become more meaningful, which will increase the likelihood of being recalled more quickly and accurately (Grant et al., 1998). According to Miller (1956), the maximum number of items a person can remember is seven, give or take one or two items. Dance movements are typically counted from one to eight; thus, by encoding information (or movements in this case) in groups of eight, cognitive load is decreased and working memory capacity is increased. These groups of “8-counts” are additionally grouped together to make combinations. Because movements are remembered in combinations, once the first movement of the combination is recalled, the remaining movements from that same combination will be recalled more quickly. This is because counting and grouping movements compresses the learned information, thus increasing available capacity in a person’s working memory. The larger the capacity is for certain stimuli, the faster new information can be learned (Nikolić & Singer, 2007).

Participants in the organization condition are also hypothesized to perform better than participants who are not exposed to any strategy. This is because they are exposed to techniques that will teach them to categorize information as it is presented. One of the ways to increase working memory efficiency is through the process of chunking, or grouping (Miller, 1956). In the present study, there is a heavy load on one’s working memory when playing this video game because of the large number of movements.
presented at a fast pace. By increasing memory load, working memory capacity is
decreased (Becker & Morris, 1999). If working memory resources are exceeded, learning
will be ineffective (Cooper, 1998). To increase the efficiency of working memory capacity,
so that more cognitive resources can be freed and processing of more information can
happen more quickly, the movements can be stored in categories as they are presented.
For example, participants can classify the movements into those that correspond with the
chorus and those that correspond with the verses of a song. Once they have categorized
them, they are able to recognize and associate specific movements with specific parts of a
song.

According to the Law of Proximity in Gestalt Psychology, separate items that are
near to one another are perceived to be a single unit (Lidwell, Holden, & Butler, 2003),
and the Law of Similarity states that items that are similar to each other are also perceived
as a single unit (Lidwell et al., 2003). If these concepts are applied to effectively learning
choreography, the organization strategy can help participants better understand the
structure of the dance, thus improving their processing and memory of the dance steps.
Movements that follow each other in a sequence are going to be viewed as a combination
(proximity), and those movements that are part of the chorus are always going to be
similar to each other (similarity). This categorization into “units” also increases working
memory efficiency by decreasing cognitive load.

Recognition, or the ability to recognize previous events, facts, or in this case,
dance movements, is a part of declarative memory (Stark & Squire, 2001). When people
use stimuli to trigger memories of these facts or events, they are using associative
recognition. Categorizing movements with different parts of a song allows participants to build associations between the choreography and the song. Because of this, when participants hear the chorus, they will be able to more quickly recall the movements that they already performed during a specific part of the song, and the same applies for the verses of the song. Creating associations causes neurons in the hippocampus to overlap because the movements will have the shared characteristic of belonging to the same category, thus decreasing the memory capacity needed to recall the movements and increases the capacity for learning more information (Harlow, MacKenzie, & Donaldson, 2010). Thus, it is hypothesized that categorization and association will improve participants’ memory of the dance sequence, resulting in a higher score.

It is additionally hypothesized that participants who are exposed to the combined strategy condition (i.e., organization and counting) will have higher scores than participants who receive both strategies separately. It is possible that, due to an overload of information from both strategies, participants may be more confused and distracted, which may cause them to abandon efficient use of any particular strategy. However, it is expected that, with exposure to both techniques, participants will perform better than participants who are only exposed to a single technique.

Given the vast array of the multicultural population at the university where data collection took place, it is possible that men and women will differ in their performance on learning and performing a dance sequence. Thus, potential gender differences will be assessed in the study.

The main goal of this study is to use experimental methods to test ways of
combining cognitive and human factors psychology techniques in order to improve how fun, effective, and intuitive games that incorporate physical actions are to play. The findings may potentially suggest ways to improve the efficiency of the *Just Dance* video game training regimen.
CHAPTER III

METHODOLOGY

Participants

One hundred (100) students from California State University, Northridge over the age of 18 were randomly assigned to either the control or experimental condition and were awarded class credit for their participation. Participants registered to participate in the experiment through a human subject pool management software system used by this and other universities.

Materials

*Just Dance video game.* The video game *Just Dance* for Nintendo Wii is designed to teach its users how to dance using a simulated image of a dancing person that performs the dance sequence. There is no training portion for the program; instead, the user tries to learn the dance combination by mimicking the pattern of movements of the simulated image, and executing them along with the simulation. A two-part sensor device attached to the user detects the accuracy of the player’s execution of movements. If the player is performing the correct movements with the correct body part at the correct time, the player’s score will increase. The score is provided as feedback on the screen while the player is dancing. The players also have the ability to choose which song or music they want to dance to, limited to what songs are provided on the particular version of the game they are playing. For the purposes of this experiment, all participants used the same version – *Just Dance 3*. There are three levels of play: “easy,” “intermediate,” or “advanced.” To obtain results for this study, all participants experienced the
“intermediate” level of the game.

**Strategy.** A 15-minute slide show of the proposed strategy was played on computers using Microsoft Powerpoint. There were four conditions: (1) control, (2) counting strategy, (3) organization strategy, and (4) counting and organization strategies combined. The fourth condition combining both strategies dedicated seven and a half minutes to one strategy and seven and a half minutes to the other. The slide show began with brief instructions informing participants about what they were about to see (see Appendix 4). They were told to be attentive to a specific strategy that the slide show would illustrate, and they were also told that they might be asked to recall information they read during the strategic tutorial.

First, participants read the title of the strategy and its definition to ensure they understood its meaning in the context of this study. Second, they received a few examples that demonstrated the strategy technique. For example, for *organization*, participants were told:

“Try to group movements into categories. Focus on the movements that are demonstrated during the verse of a song separately from the movements that are demonstrated for the chorus of the song. The verses of the song appear at the beginning, middle, and end of a composition, maintaining a similar rhythm and melody for each verse. The chorus, which is rhythmically and melodically different from the verse, is the most repeated and most memorable part of a song or musical composition (Logan & Chu, 2000). Hint: The chorus of a song or dance appears
various times in a song or routine. Therefore, you should focus on identifying and learning the chorus first, as it will repeat. Because it is so repetitive, if you learn the “chorus” movements first, they will already be stored in long term memory, thus making more of your cognitive resources available to learn the next sequence of movements for the new upcoming verse.”

Once this step-by-step tutorial was presented for one of the three conditions (one type of tutorial for each condition), the participants moved on to the physical portion of the study where they interacted with the video game. The control group did not receive the same slide-show tutorial. Instead, they read and watched a presentation for the same amount of time about dance history, which did not include any information about strategies or techniques for learning or teaching dance. After exposure to the unrelated dance presentation, participants from the control condition also interacted with the video game.

**Post-task survey and quiz.** Participants received a subjective memory survey which read: “Ignore for the moment how well or poorly you performed in the game, and please rate on a scale below how well you estimate that you remember the dance moves that you attempted to learn during the game.” Response choices were provided on a 7-point Likert scale, and anchors were present for ratings of 1, 4, and 7, where a response of ‘1’ indicated “not remembering any moves,” a response of ‘4’ indicated remembering “some moves,” and a response of ‘7’ indicated remembering “all moves.”

Participants were also given a quiz after the completion of two rounds of the *Just Dance* video game (see Appendix 1). A series of screen shots from the video game were
displayed on a piece of paper. The first part instructed participants to place the screen shots in the correct order of the dance sequence they had just learned. In the second part, participants were asked to identify (from multiple choices) which movement came next after a given series of screen shots. There were a total of ten questions, with ten possible correct answers. The total number of correct responses was recorded as a dependent variable indicative of participants’ memory of the choreography.

**Motivation and experience survey.** The preconceived attitudes participants had about dance may have influenced their motivation to perform well in this study, which in turn was thought to affect their final performance. Therefore, it was important to obtain a measure of participants’ attitudes and behaviors with respect to dance or exercise activity similar to dancing. Participants were given an experience survey assessing their previous experience with dance video games and dance in general (see Appendix 2). In addition, they were asked to rate how much they enjoyed dancing on a seven point Likert scale, where a response of ‘1’ indicated “not at all,” a score of ‘4’ indicated a “neutral” attitude, and ‘7’ indicated liking to dance “very much.”

Each participant was also asked at the end of their Just Dance experience, “How motivated were you to successfully complete the previous task?” Participants selected a response on a seven point Likert scale where a response of ‘1’ indicated “not very motivated,” a score of ‘4’ indicated “neither motivated nor unmotivated,” and a score of ‘7’ indicated “very motivated.” Please see Appendix 2 for an example of this survey.

**Product survey.** At the completion of the experiment, participants were asked several questions regarding the product from a marketing perspective (see Appendix 3).
They were asked to rate (on a seven point Likert scale) how much they liked the video game, where a response of ‘1’ indicated “not at all,” and a response of ‘7’ indicated liking the game “very much.” Participants were also asked to estimate a price for the video game should they want to purchase it. Lastly, if there were certain features that the participants especially liked or disliked about the game, they were asked to provide feedback about the features on this survey.

**Working memory.** Working memory capacity was measured using a computerized automated two-back test (http://cognitivefun.net). Participants watched a demo of the test first before completing it. Once they confirmed that they understood the goal of the test, they completed the automated two-back test and their score was recorded. The score was illustrated as a percentage (out of 100) of correct responses.

**Design**

This study was a 2 (gender: men and women) x 4 (training: control, counting, organization, combination) quasi-experimental study designed to test the effects of one of three particular strategies on learning and remembering a dance sequence (measured by the score on the *Just Dance* video game and a post-task memory quiz). The manipulation was which of the three 15-minute strategies participants received, and how their performance compared to the control condition. The first one was the counting variable with two levels: counting absent and counting present. The second one was the organization variable with two levels: organization absent and organization present. The combination strategy was analyzed as counting present and organization present, a combination of the former two levels. There was a “dangling control group” for
participants that did not experience the strategy and instead read an article for the equivalent 15 minutes about the history of hip-hop dance, not related to any of the techniques presented in the strategy.

There were two dependent variables. The first dependent variable was the performance of each participant in the first and second rounds of the Just Dance video game. The second dependent variable was participants’ score on the post-task memory quiz. Three covariates that were considered in this study were (1) preexisting dance experience, (2) motivation ratings (as measured by the post-task motivation and experience survey), and (3) working memory capacity (as measured by the computerized automated two-back test). The first and second covariates, motivation and experience, tested if participants who enjoy dancing in comparison with those who do not enjoy dancing differed in performance scores, depending on their existing attitudes and experiences about dance, and not necessarily depending on their exposure (or lack of exposure) to the strategy. The third covariate, working memory capacity, was used to assess the relationship between the ability or inability to remember a specific set of consecutively presented information and participant performance.

**Procedure**

After obtaining informed consent from the participants, they completed a demographic questionnaire, indicating their age, class standing, and gender. Participants were randomly assigned to conditions as they showed up to the study. All participants completed the working memory task prior to exposure to the strategy. Those in the experimental condition then viewed the 15-minute strategy tutorial slideshow “Learn to
Dance!” while the control condition viewed a slideshow about the “History of Hip-Hop Dance.” Following the PowerPoint session, participants from both conditions played two rounds of the Just Dance video game.

Participants completed a practice round so they could become familiar with the logistics of the game. Participants then completed a second round, which was recorded as participant performance. Playing the game twice gave participants the opportunity to be exposed to the dance sequence more than once, and to practice organizing the dance steps and counting the movements to increase their score on their performance. For the control condition, participants also had a chance to play the game twice. All participants played the same single-player level, with the same song and dance set on intermediate level. After completing the game, each participant was asked to complete a motivation survey asking how motivated they were to perform this task. They also answered questions assessing their previous dance experience. The entire study lasted approximately 30 minutes. Participants were debriefed at the conclusion of the experiment.

All instructions were read from a script (see Appendix 4). When participants arrived at the testing site, they received the first set of instructions prior to beginning the slideshow. Special attention was directed to the working memory task and notifying the experimenter when the task was complete before resuming the slideshow. Following the slideshow, a second set of instructions was read pertaining specifically to the purpose of the video game and technical aspects of using the Wii. Before beginning any portion of the experiment, participants were asked if they had any questions. The experimenter remained in the room for the entire duration of the study. However, participants were informed that
the experimenter would not be able to answer any questions *during* video game interaction. When questions arose during the first round, they were addressed before participants began round two.
CHAPTER IV

RESULTS

The original hypothesis of this study was that with the use of one of the three proposed strategies (i.e., organization, counting, or both) participants would be able to learn and remember a dance sequence more effectively, which would thus increase their performance in a dancing-based video game. It was also hypothesized that females would perform better than males, given that females are more likely to enjoy dancing activities (O’Neill, Pate, & Liese, 2011), and would thus be more skilled at executing the movements correctly. The data were screened for normality and assumptions. No outliers were found, and there were no missing data.

A between-subjects 2 (men and women) x 4 (training) MANCOVA was used to analyze four different outcome variables in this study (i.e., practice game score, final game score, subject memory rating and quiz score) while controlling for working memory, motivation and dance experience. We expected the multivariate tests to show significant main effects for both the gender and training conditions and a significant interaction between gender and training on the combined dependent variables. Using Wilks’ Lambda criterion we found that both motivation (Wilks’ Lambda = .770, $F(4, 86) = 6.42, p < .001$, \(\text{partial } \eta^2 = .230\)) and dance experience (Wilks’ Lambda = .882, $F(4, 86) = 2.87, p = .03$, \(\text{partial } \eta^2 = .118\)) were significant covariates for the combined dependent variables, but working memory (Wilks’ Lambda = .973, $F(4, 86) = .60, p = .66$, \(\text{partial } \eta^2 = .027\)) was not. While controlling for motivation and dance experience, the multivariate effect for training was significant (Wilks’ Lambda = .742, $F(12, 228) = 2.27, p = .01$, \(\text{partial } \eta^2 = \))
.095) but the effects for gender (Wilks’ Lambda = .955, $F(4, 86) = 1.01, p = .41$, partial $\eta^2 = .045$) and the interaction (Wilks’ Lambda = .811, $F(12, 228) = 1.57, p = .310$, partial $\eta^2 = .068$) were not.

It was hypothesized that participants who were exposed to either of the three strategies would perform better and receive higher scores when playing the *Just Dance* video game in comparison to the participants who were not exposed to any strategy, while controlling for motivation and previous dance experience. Results of univariate effects revealed that participants who were in the counting, organization, or combination condition performed better than participants in the control condition, while controlling for motivation and previous dance experience, $F(3, 89) = 3.79, p = .01$ (see Figure 1). More specifically, pairwise comparisons across levels of the strategy condition revealed that participants in the counting condition significantly outperformed participants in the control, organization, and combination conditions, while controlling for motivation and previous dance experience (see Table 1). There was no main effect of gender on video game score, $F(1, 89) = .30, ns$. There was no significant interaction of condition by gender on video game score, $F(3, 89) = .94, ns$. 
Table 1

**Means and Standard Deviations of Dependent Variables by Condition**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Practice Score</th>
<th>Final Score</th>
<th>Subj. Mem</th>
<th>Quiz</th>
<th>Prev. Exp.</th>
<th>Game Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>5027(1664)</td>
<td>6187(1901)</td>
<td>4.76(1.27)</td>
<td>3.96(1.27)</td>
<td>3.76(1.56)</td>
<td>5.28(1.67)</td>
</tr>
<tr>
<td>Count</td>
<td>6407(2020)</td>
<td><strong>7903(1675)</strong>*</td>
<td>4.74(1.32)</td>
<td>4.78(1.81)</td>
<td>4.65(0.98)</td>
<td>5.43(1.31)</td>
</tr>
<tr>
<td>Organize</td>
<td>5168(2063)</td>
<td>6253(2177)</td>
<td>4.60(1.22)</td>
<td><strong>5.12(1.72)</strong>*</td>
<td>4.44(1.26)</td>
<td>5.48(1.05)</td>
</tr>
<tr>
<td>Combo</td>
<td>5457(2352)</td>
<td>6570(2458)</td>
<td>5.15(1.03)</td>
<td>4.67(1.49)</td>
<td>4.07(1.62)</td>
<td>5.26(1.70)</td>
</tr>
</tbody>
</table>

*Figure 1. Mean final *Just Dance* scores for each condition.*

Scores on the post-task memory quiz were also predicted to be higher for participants in the counting, organization, and combination conditions relative to the control group, while controlling for motivation and previous dance experience. Quiz score was indeed found to be dependent upon participant condition, $F(3, 89) = 2.86, p = .04$, while controlling for motivation, and previous dance experience (see Figure 2). Only participants in the organization condition significantly outperformed those in the control
condition (see Table 1). Trending results also indicated that participants in the organization condition outperformed those in the counting and combination conditions, as well; however, those differences were not significant. Quiz scores were not found to be dependent on gender, \( F(1, 89) = 2.40, \text{ns} \). However, there was a significant interaction between condition and gender on quiz score, \( F(3, 89) = 3.49, p = .02 \).

Unexpectedly, the analysis also revealed that approximately 47% of the population reported playing this game before. For this reason, a separate MANCOVA was conducted to test the same hypotheses using only the group of people who reported that they had not played the game before. Data were trending that there was a main effect of strategy on video game score, but given such a small sample size, no significant differences were found, \( F(3, 41) = 2.50, p = .07 \).

Data were also trending to show a main effect of strategy on quiz score, but again, given the small sample size, this effect did not test to be significant, \( F(3, 41) = 2.51, p = .07 \).

The other half of the population, who did report playing the game before, was also
analyzed separately; however, no significant differences were found.

An additional between-subjects two-way ANOVA was conducted to test whether the cost participants would be willing to pay to purchase the *Just Dance* video game was dependent upon how much they liked to dance and how much they enjoyed playing the game (as measured by the Product Survey). Results indicated that participants’ rating of how much they like to dance was not significantly affecting the suggested cost they would pay to purchase the game, $F(6, 71) = 1.85$, $ns$. However, participants’ rating of how much they liked the game significantly affected their suggested cost, $F(6, 71) = 3.96, p = .002$. In addition, results indicated an interaction effect of liking dance and liking the video game on suggested cost, $F(16, 71) = 2.05, p = .02$. Thus, it is concluded that people who enjoyed playing the game are more willing to pay more money if they were to purchase it.

Participants’ rating of motivation, previous dance experience, and working memory were the covariates in this study. It was hypothesized that those who are more motivated, who have more dancing experience, and who have higher working memory scores will have higher performance and quiz scores, compared to participants who are less motivated, have less experience, and lower working memory scores. It was hypothesized that these variables will all be positively correlated with video game score and quiz score.

Bivariate Pearson correlations were used to assess the relationship between motivation and participants’ *Just Dance* scores. Results revealed that there is a significant and positive relationship between motivation ratings and video game score, ($r = .42, p < .001$). In other words, the more motivated participants were, the better they performed on
the task. Participants’ ratings of how much they like to dance were also positively and significantly correlated with their video game score ($r = .46, p < .001$). The correlation between motivation and quiz performance was also significant, ($r = .23, p < .05$).

Motivation also seemed to relate to participants’ scores on the memory quiz. An additional correlation between previous dance experience and video game score also revealed a significant and positive relationship, ($r = .23, p < .05$). This suggests that those who have played this game before or those who have previously taken dance classes will perform better on the video game. However, the correlation between previous dance experience and quiz score was not significant.

Working memory assessment was the third covariate in this study. It was hypothesized that those who have higher working memory will perform better on learning, remembering, and performing the dance sequence correctly in comparison to those participants who have lower working memory capacity. A third Pearson $r$ correlation determined the relationship between participants’ scores on the computerized automatic two-back test and dance performance after playing the video game. It was hypothesized that higher scores in the working memory measure would correlate with higher performance scores, given that participants have an advantageous individual difference of being able to remember more items with which they are quickly presented. The analysis revealed that there was no significant relationship between working memory and video game performance. When working memory was correlated with quiz performance, results indicated a negative (but not significant) relationship between the two variables ($r = -.09, ns$). Although the strength of the correlation does not meet criteria of significance, it is
interesting that the relationship is inversed.

Additional correlations were conducted to assess the relationship between performance score on *Just Dance* and quiz performance. Results illustrated a strong and significant, positive relationship between the two dependent variables ($r = .34, p < .001$). This was expected, given that both variables strive to measure participants’ learning and memory of the choreography. Thus, if the participant scores well on one, he or she would predictably score well on the other.

Participants’ performance on the video game was also predicted to correlate with ratings of liking the video game. Pearson correlations confirmed this by indicating a positive and significant relationship between video game score and game rating ($r = .35, p < .001$), which also correlated with the suggested cost participants would be willing to pay for the video game ($r = .32, p < .01$).
CHAPTER V
DISCUSSION

I predicted that the use of strategy would be effective in improving participants’ ability to learn and remember a dance sequence, and thus improve their performance score on the *Just Dance* video game and on the post-task memory quiz. This hypothesis was partially supported. Originally, it was hypothesized that exposure to either of the strategies (i.e., counting, organization, or combination) would result in higher video game and quiz scores. Furthermore, it was hypothesized that the combination condition would result in the highest video game score and the highest memory quiz score. However, predictions about the effectiveness of the combination condition proved to be false. Only the counting condition yielded significantly higher video game scores, but not higher quiz scores. Participants in the organization condition scored higher than all other groups on the memory quiz. Thus, the combination condition proved to be less effective than either the counting or organization strategies alone, as measured by either video game score or the memory quiz.

According to the results of the analysis, training dancers using counting strategies may be effective, especially for first-time players, as demonstrated by the trending effect illustrated by the split-cases analysis. The counting training seems to have an immediate effect on participants, which is evident by their significantly higher practice round scores, as well as final performance scores. The analysis of new players alone confirms that those who played the game for the first time are the ones driving the effect. Perhaps counting is more helpful at the encoding stage, when information is first being processed, while
organization is more helpful for storage of information in long-term memory, thus also being helpful during memory recall. Counting seemed to assist participants in performing the correct movements at the correct time while playing the game, but organizing the movements into categories seemed to assist participants in recalling the movements better. The combination condition may have been too overwhelming for participants to learn in under 30 minutes, because participants may have split their attention and cognitive resources between the two strategies, and in turn become distracted from the game, which hindered their recall of movements on the quiz.

Also, contrary to the hypothesis, men and women did not significantly differ on video game or quiz performance. In fact, the interaction of gender by strategy condition indicated a significant difference in video game scores, but men had higher means than women. Again, this contradicted the hypothesis that women would outperform men, because they enjoy dancing more and have more experience with dance than men.

In addition, motivation and experience proved to have significant and positive relationships with participants’ performance, while working memory did not. As expected, participants who were more motivated to play the game actually performed better on the task, which led to higher ratings of the video game and higher suggested costs for how much they would pay if they were to purchase the game. It is understandable that people are willing to pay more for products that they enjoy or that bring them positive experiences. This is important for designers to consider so they can design the game to be more efficient, accurate, and representative of their users’ abilities. Making the game easier to follow will allow players to learn the movements more accurately and to obtain
higher scores, and will directly result in higher satisfaction with the product. Higher satisfaction with their product might lead to an increase in willingness to purchase the product for a higher price, which might eventually lead to more sales.

Contrary to the hypothesis, working memory capacity did not have a significant and positive relationship with dance performance. However, the data analysis did reveal a trend towards a significant relationship. Interestingly, this trend suggested that working memory might be negatively correlated with working memory capacity. Again, the data analysis of this relationship was inconclusive, but perhaps those with lower working memory may be obtaining higher scores on the game due to a novelty effect, assuming that they had never played the game before. Because it is new and interesting to them, they are more likely to remember the sequence of movements better, and thus perform them more accurately in the final round of interacting with the game.

**Implications for Design**

Taking the results of this study into consideration, it may be possible to alter the visual effects of the video game to include counting information on the screen by revealing a count simultaneously with each movement. Also, given that most of the songs on the *Just Dance* games are simple songs from an organizational perspective; most of them follow a verse-chorus-verse-chorus format. The game, just like the music the dances in the game correspond with, are also designed to have repetitive movements each time the chorus occurs. Therefore, it may also be beneficial for users to have some advanced indication of the upcoming section in the dance: either the chorus or the verse.

Officials of software companies, along with their design teams, claim that “dance
games based on motion control have great potential” (Bruno, 2010, p. 18), and they believe that the success of their game is determined by the “appeal of their graphics or of the controller” (p. 18). However, there is more to consider when designing a product than a pretty design. It is important for a product to function the way that it is advertised to function. The main goal of the designers of Just Dance, or any interactive dance-instructional game, is to teach people how to dance. Because of this, they should consider the learning process, techniques, and strategies that are involved in teaching dance.

Implementing these changes may have the potential to increase the gratification customers have after purchasing this, or any similar physical fitness or instructional product, and successfully learning how to dance. These changes may also provide potential for health benefits related to increased physical activity and exercise. In fact, the American Council on Exercise and Centers for Disease Control and Prevention revealed that an increasing amount of technology-based interactive fitness games are being developed and aimed at young adults and teenagers (Kasland, 2008). Unfortunately, less than 36% of the population is exercising at rates necessary to stay healthy (Kasland, 2008). There is a hope that with the development of a fun and innovative way to exercise (such as an interactive dancing video game), these statistics will increase.

**Implications for Practice in Dance Education**

Various personalities in the dance domain can benefit from the results of this study. From the pedagogical standpoint, dance instructors in schools, dance academies, or private studios can incorporate these techniques into their lesson plans to facilitate an increase in learning among their students. Teaching dances to students in an organized fashion that
will help them remember the sequence and pattern of movements correctly is the first step in applying this strategy to the classroom. Using these techniques, instructors can apply the strategy in two ways: (1) instruct the students on how to categorize, cluster, and organize what they learn in the classroom; and (2) teach the dance sequences in that same organizational pattern. For example, instead of starting from the very beginning of a choreography, an instructor can teach the chorus combination first. As mentioned earlier, because this part of a song or musical composition tends to repeat, the corresponding dance movements (for the most part) will repeat as well. So, the students can categorize their newly learned combination as “the chorus.” Secondly, the instructor can teach a new combination that will correspond with the first verse or the first section of a piece of music, followed by the chorus, which the students already learned. This allows students to link the verse and the chorus, giving them another opportunity to repeat the chorus step, and to inevitably get closer to the end goal (i.e., completing the dance sequence).

Presenting new combinations and sequences in the aforementioned manner and adding counts to the instruction will also benefit the students. It may not be enough to just repeat commands (e.g., right, left, up, down, cross, touch-step) when trying to teach a dance sequence. Assigning a count to each movement will allow students to organize their steps and keep them on time with the rhythm of the music, accompaniment, etc. In some cases, groups of dancers perform foot-stomping patterns without any musical accompaniment, and leaving them without a reference for rhythm or tempo. This is an especially important situation in which counting plays a critical role for everyone to maintain the correct rhythm and stay in unison. It may be helpful for instructors to have
students count out loud as they are executing the movements so that they become accustomed to counting by themselves for practicing and performing purposes. In very complex (e.g., syncopated, very fast, or very slow) rhythmic sequences, it may be helpful for instructors to ask students on which count a particular movement occurs so that they will be forced to identify the count on their own. By thinking about questions like this, the students are building associations and connections between movements, which may increase their ability for recall, organization, and ultimately, for their final performance.

Lastly, it is important to consider the various levels of dance knowledge that students have. While professionals, amateurs, and students who want to learn how to dance or enjoy dancing enroll in dance classes, there are also students who enroll to fulfill a particular school requirement, or those who are forced to take classes for a particular upcoming event (e.g., bar mitzvah, quinceañera, wedding, etc). Given the results that motivation is positively correlated with performance, instructors should try to develop ways to engage those students who are otherwise unengaged. In other words, dance teachers should try to find a way to interest and motivate their students who are not skilled dancers, for example, or those who are shy, embarrassed, or simply do not enjoy the activity at all. One possible way to do this is using the proposed techniques of organization and counting because these methods will increase learning and recall of the dance sequence. Once the students realize that they are able to learn and remember the dance, or at least the chorus (or verse, or chorus and verse), their self-esteem may be increased, and their motivation to learn more might also increase. Because the results show that
motivation leads to increased performance, instructors can expect to see better performance in the students who they are able to successfully motivate.

Recent research suggests that dance educators are more frequently incorporating the use of technology into their curriculum than in the past (Doughty, Francksen, Huxley, & Leach, 2008). Therefore, the results of this study may be used to augment, or choose between, potential methods of computer-assisted instruction in dance schools or dance programs. More specifically, these programs should be augmented to present sequences to students in combinations, not as separate individual movements. However, each combination should not exceed eight counts or eight movements. Ideally, these programs will have a demonstration part, which can be followed by an interactive quiz or self-check episode to ensure that learning is taking place. Depending on the genre of dance and tempo of the music, instructional programs may be designed to help students identify the rhythm and count the beats prior to any physical demonstration of movements. Thus, should instructors decide to assign students to learn dance sequences via technology such as a simulation, videogame, or interactive video tutorial, they should still consider incorporating the two techniques of organization and counting into these mediums.

Implications in Other Fields

Domains unrelated to product design or dance education may also benefit from the results of this study. These fields may require similar skills to the ones presented in this study such as quick learning of information and immediate application of that information for adapting to specific situations. One such example is emergency planning. In the event of an emergency, people may be forced to evacuate a certain area in a very short amount
of time. There has to be a specific strategy or plan, which corresponds with specific
instructions that must be followed for everyone to evacuate quickly and safely. In this case,
both timing and movement (from one place to another) is critical.

Similarly, in the military context, soldiers are taught to attend to, remember, and
follow strategies very quickly so they can later utilize them in a variety of situations. Given
the unpredictable situations presented in a military environment, adaptation is critical, and
can be improved using the strategies they previously learned. Even more similarly, these
skills can be especially useful for members of a military marching band, in which timing and
movement must be incredibly precise. Soldiers must be able to quickly adapt to the
“performance grounds” when marching, to march correctly and in synchrony with each
other (by using counts), and while immediately reacting to the orders called out by their
leader (and associating movements with the command).

Employees working in an assembly line may also require similar skills to
successfully do their job. For example, everyone in an assembly line is responsible for a
series of tasks, which are part of a larger procedure. The tasks are performed quickly, in a
nonstop fashion, and employees must constantly be alert and ready for the subsequent task.
This places a heavy load on their working memory. It is likely that once employees have
become very familiar with their routine of tasks, they develop a specific rhythm for which
they cycle through these tasks. If this “rhythm” is disturbed, or they lose track during their
task (e.g., miscount an item, put it in the wrong place) they have to be able to adapt to the
distraction quickly and resume the rhythm of their routine.
Future Research on Dance and Cognition

One additional cognitive domain that plays an important role in the study of dance is visualization and mental imagery. Granted, the more a person physically practices a certain movement or set of movements, the better he or she will become and the closer he or she will be to mastering the routine (Stinson, 1985). However, the idea of mental imagery can also be beneficial to dancers, just as it is among athletes (Glisky & Williams, 1996). Mental imagery refers to imagining and visualizing how one’s body moves, without actually moving it. For example, if a dancer has been rehearsing and practicing for a long time, fatigue will increase and physical ability to continue will decrease.

Nevertheless, just because people cannot physically practice something does not mean they cannot do so mentally. It may be just as effective to turn on the music for the dance sequence and imagine the dance sequence performed, step-by-step, to the music, as if it were being performed physically. Enghauser (2007) describes this as the mind-body connection in which learning dance sequences requires not only somatic experience, but also mental representations. Kassing and Jay (2003) suggest that imagery supports the teaching of dance effectively because it assists students in visually building connections between movements in long term memory. Visualization exercises may increase the speed, and decrease the difficulty with which movements are later recalled from memory when it is time to give the performance of the newly learned material.

Future research might add this technique to the dual strategy and test if increases in learning, recall, and performance will occur. Given the short duration of this study, having a visualization measure was not possible. However, future studies might allow
participants to complete one round of learning a dance sequence using the organization
and counting techniques followed by a second round in which participants do not
physically practice the movements, but are instructed to imagine and visualize which
movements should appear in the sequence.

Limitations

There are several limitations to this study. First of all, the objective performance
measure used in this study may not be an ideal assessment of learning or performance
ability. The Just Dance videogame uses technology to assign a score based on how well a
participant can follow the dance sequence being shown on the screen in real time. The
score is determined by a sensor in the form of a wristband, which the player must wear on
his or her right hand. In addition, the player must stand within a given distance of that
sensor in order for the movement to be detected. Should a player perform the correct
movement, but be too far from the sensor, the game will not detect the movement, and
thus will not increase the score. This may be a technological error that may interfere with
results of the experiment. Therefore, other measures of participants’ performance may be
used to obtain more accurate measures. For example, participants may be videotaped and
asked to perform the dance sequence from memory. Then, those videotapes can be shown
to judges who are blind to participant conditions, and asked to compare the participant
video with the dance sequence in the videogame. Using inter-rater reliability on these
judgments, a more accurate and reliable score might be calculated for each participant’s
learning and performance ability.
Secondly, the video game is designed to give high scores to the player that executes the correct movements at the correct time. What if a participant knows the movements and is performing them in the correct sequence, but is either too fast or too slow? This does not suggest that the participant did not successfully learn the dance; it may simply be a problem with timing of movement execution. Therefore, the score given by the video game at the end of the task is not a very accurate measure of learning alone. Because most of the points (if not all) are obtained by executing movements at the exact time, the final score does not solely represent the participants’ learning.

A third limitation is that participants did not have as much time to learn the dance sequence as they would have had in a typical dance class or workshop. Although many dance instructors and choreographers expect dancers to learn choreography quickly, they usually have more than ten minutes to learn and memorize a dance sequence. Participants in this study did not have the opportunity to spend a significant amount of time observing, repeating, and performing the sequence, as they would in a dance class. They were also not able to ask the instructor (which in this case is a videogame) for clarification on a movement if they had a question about how to execute it. For these reasons, the desire to create a “classroom-like” or “instructional” setting was not successful. On the other hand, it is very typical for professional dancers who audition for dance companies to be faced with similar situations. Thus, in this case, the contextual conditions of such a fast-paced learning environment would be congruent with this experiment.

Finally, users who purchase instructional dance videogames (such as Just Dance) know that they will not receive one-on-one instruction and are basically playing “follow
the leader” with their television screen, and they are therefore unlikely to be upset with their possible poor performance. However, if the goals of this study are realized, there may be the potential to increase the gratification customers have after purchasing a similar product to Just Dance and successfully learning how to dance. There may also be potential to enhance health benefits related to increased physical activity and exercise.
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APPENDIX 1

Memory Quiz

Directions: Please number the images below, from 1 to 7, in the order they were presented in the dance you just learned.
8. Which movement comes next in the following sequence?

A  B  C  Answer: _______

9. Which movement comes next in the following sequence?

A  B  C  Answer: _______
10. Which movement comes next in the following sequence?

Answer: _______
APPENDIX 2

Example of Motivation and Experience Survey

**Motivation Survey**

How motivated were you to successfully complete the previous task?

<table>
<thead>
<tr>
<th>Not motivated</th>
<th>Neither motivated or unmotivated</th>
<th>Very motivated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Experience Survey**

1. Have you previously ever played the video game *Just Dance*? (Please circle one)
   - Yes
   - No

2. Have you ever played a video game similar to this one (i.e. *Dance Kinect, Dance Dance Revolution*, etc)? (Please circle one)
   - Yes
   - No

3. How would you rate your overall (lifelong) dance experience?
   - Not experienced
   - Somewhat experienced
   - Very experienced

<table>
<thead>
<tr>
<th>Not experienced</th>
<th>Somewhat experienced</th>
<th>Very experienced</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
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<td>6</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. How much do you like to dance?
   - Not at all
   - Don’t like it or dislike it
   - Very much

<table>
<thead>
<tr>
<th>Not at all</th>
<th>Don’t like it or dislike it</th>
<th>Very much</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
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<td>7</td>
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</tbody>
</table>
APPENDIX 3

Product Survey Example

<table>
<thead>
<tr>
<th>Product Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How much do you like this game?</td>
</tr>
<tr>
<td>Not at all</td>
</tr>
<tr>
<td>Don’t like it or dislike it</td>
</tr>
<tr>
<td>Very much</td>
</tr>
</tbody>
</table>

2. How much would you be willing to pay if you were to purchase this product? (Please write a $ amount) $ ____________

3. What did you particularly like about this game?
   ____________________________________________
   ____________________________________________
   ____________________________________________

4. What did you particularly dislike about this game?
   ____________________________________________
   ____________________________________________
   ____________________________________________
APPENDIX 4

Introductory Instructions for Participants

Instructions for Participants – Part 1

Welcome, and thank you for your participation in this study. Please take a seat at this computer, and make yourself comfortable for the next fifteen minutes. For the first part of this experiment, you will be viewing an automated slideshow.

Please note: At some point towards the beginning of the slideshow, you will be prompted to click a link labeled “click here,” which will direct you to an online puzzle game. When you have completed the game, your score will be displayed on the screen. Once your score is displayed, please notify the experimenter that you are finished, so that he/she can record the score. Once your score is recorded, you may close the browser and resume your slideshow.

Please notify the experimenter if you have any questions or problems during the slideshow. Do you have any questions?

Please press the spacebar when you are ready to begin your slideshow.
APPENDIX 5

Video Game Instructions for Participants

Instructions for Participants – Part 2

Congratulations! You are ready to move on to the second part of the experiment. Now you will have a chance to interact with the video game Just Dance for Nintendo Wii. When playing the game, your goal is to apply the techniques and strategies you just learned from the slideshow *

The goal of this game is to follow along and copy the dance moves that you see the person doing on the screen. This wristband is a sensor and will be attached to your right wrist. The second sensor is placed here on the top of the TV screen. Please stay within the red boundaries enclosed by the red tape on the floor. If you step outside the red tape, the sensor will not be able to capture and recognize your movements, and your score will be affected. For the same reason, please try to avoid holding the remote upside-down.

You will have a chance to play the game twice. The first will be a practice round so you can familiarize yourself with the game. The second round will be considered as your final performance. After you complete the first round of the game, your score will be displayed on the screen. Please do not touch the remote until the experimenter records this score. Immediately following the first round, you will perform the same dance once more. Again, your score will be displayed after you are finished, and the experimenter will record your score. The experimenter will not be able to answer any questions during the first or second round. If you have any questions, please wait until the practice round is finished to ask to the experimenter. Do you have any questions? Please press “OK” in the center of the remote when you are ready to begin.

* This sentence will be read for participants in the counting, organization, and combination conditions. This sentence will not be read to participants in the control condition.