An Analysis of a Board Game as a Treatment Activity

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Occupational therapists often use tabletop board games in treatment to help adult clients with physical disabilities improve the perceptual, cognitive, sensory, and fine motor skill components of occupational behavior. Detailed activity analyses of these types of activities, including performance norms, are not available in the occupational therapy literature. Such analyses would help therapists consider the multiple skill demands of tabletop games and allow more systematic grading of these treatment activities. This paper presents a model for analyzing therapeutic activities in relation to relevant motor learning and cognitive-perceptual literature. Included in this analysis are a description of the activity, examination of its component skills and of the qualitative features of activity performance, suggestions for grading and for treatment goals, and some preliminary performance standards derived from a pilot study of 18 adults without physical disabilities. The issue of transfer of skills between games and functional activities is also discussed.

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Occupational therapy for adults with physical disabilities frequently focuses on improving the cognitive, perceptual, and sensorimotor skill components of occupational behaviors (Barris, Cordero, & Christiaansen, 1986; Kunstetter, 1988; Neistadt, 1986). Therapists choose activities suitable to improving these skills by considering activity analysis, their educational and clinical experience with particular activities, client interests, and resources in their facilities (Barris et al., 1986). Because activity analysis is emphasized in the educational process of occupational therapists (Nelson, Cash, & Bauer, 1990), one would expect therapists to agree about what perceptual, cognitive, and sensorimotor skills are needed for any given activity. However, this agreement is not a given in clinical practice.

Rabideau (1986), for instance, found that different therapists in a large metropolitan occupational therapy department listed different configurations of cognitive skills when analyzing the cognitive components of making a sandwich and preparing a hot beverage. Bowen and Schulz, in a survey of 8 occupational therapists who had done research or writing in the area of visual perception, found disagreement about whether spatial relations perception was an important component skill for functional activities such as putting money in a billfold and putting toothpaste on a toothbrush (R. E. Bowen & T. Schulz, personal communication, November 20, 1989).

Perhaps occupational therapists disagree on what component skills are required for particular activities because there is no standard approach to identifying those skills. Different guidelines for the activity analysis process can be found in different texts (Crepeau, 1986; Hopkins & Smith, 1988; Pedretti & Zoltan, 1990; Trombly, 1989). Additionally, occupational therapy texts are generally not detailed about either the specific perceptual, cognitive, or sensorimotor skills involved in particular activities or ways to grade the requirements for these skills in those activities (Bouska, Kauffman, & Marcus, 1990; Crepeau, 1986; Hopkins & Smith, 1988; Pedretti & Zoltan, 1990; Trombly, 1989; Zoltan, Siev, & Freishtat, 1986). Analyses that provided such detail could help foster consensus and debate among therapists about their choice and grading of activities for retraining perceptual, cognitive, and sensorimotor skills in adult clients. This consensus and debate could lead to greater precision in the retraining process within and between departments. More precision and uniformity in retraining regimes could make retraining treatment outcome studies from different centers more comparable and thus contribute to knowledge about the efficacy of this approach.

This paper presents a research-based activity analysis of an adapted game that is used in the outpatient department of an acute general hospital to improve the cognitive-perceptual skills of adults with head injuries and the sensorimotor coordination skills of adults with hand injuries. Included in this analysis are: (a) a descrip-
tion of the activity, (b) examination of the component skills of the activity, (c) suggestions for grading the cognitive-perceptual and sensorimotor components of the activity, (d) examination of the qualitative features of activity performance relative to cognitive-perceptual and sensorimotor skills, (e) suggestions for some cognitive-perceptual and sensorimotor treatment goals for this activity, and (f) some preliminary performance standards for an adult population without disabilities. The performance standards provide some criteria for determining success in the activity. Criteria for successful performance are part of the activity analysis protocol suggested by Hopkins and Tiffany (1988), and are important guidelines for assessing client skills and progress during treatment (Trombly, 1989). This activity analysis can serve as a guide for use of the activity analyzed and can also provide a model for analysis of other activities used in practice.

Description of the Activity

The activity in question is a tabletop game called Hi-Q. The version of the game examined here uses a light green 16.5 in. by 16.5 in. rubber-like board in which 10 rows of 10 holes have been drilled. A black, two-dimensional cross, with all arms of the cross of equal length, is drawn in the middle of the board. Each arm of the cross contains 2 rows of 3 holes, and the center of the cross contains 3 rows of 3 holes (see Figure 1). To start the game, the player places large plastic pegs in all holes in the cross except for one hole in the center of the cross (see Figure 2). The object of the game is to remove as many pegs as possible by jumping the pegs over adjacent ones. Only horizontal and vertical jumps are allowed. Pegs that have been jumped are removed from the board, as in checkers.

The stimulus parameters of the pegs include color, size, and shape. The pegs are smooth, hard, and solid colored in green, blue, purple, red, orange, or yellow. They are about the size of clothespins; the top is slightly larger than the rest of the peg and the bottom is tapered for insertion into the board holes (see Figure 2).

The stimulus parameters of the board include color, shape, and orientation in space. The cross in which the game is played is outlined in black, which contrasts with the light green of the rest of the board. Although the entire board is covered with rows of holes, the player must be able to attend only to the holes contained within the border of the cross, which is drawn vertically and horizontally on the board.

The game is safe (there are no sharp edges to the board or pegs) and age appropriate for adults. It would appeal to adults who valued games and brain teasers and

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1Available from Flaghouse, Inc., 150 North MacQuesten Parkway, Mount Vernon, NY, 10550, or Smith & Nephew Rolyan Inc., N93 W 14475 Whittaker Way, PO Box 555, Menomonee Falls, WI 53052-0555.
Component Skills

We have identified six categories of component skills for this game: (a) motor, (b) sensory, (c) perceptual, (d) cognitive, (e) social, and (f) emotional.

Motor Skills

This game is typically played unimanually at a table with the board and pegs placed directly in front of a seated client. The game is a closed motor task, that is, the game board and the player are stationary and the performer does not have to make constant adaptations to a changing physical environment (Poole, 1991). During game set-up and play, the trunk and leg muscles make constant small concentric or shortening contractions against gravity to maintain postural control. For reaching and placing the pegs, shoulder flexors are involved both concentrically, to raise the arm against gravity, and eccentrically (lengthening contraction), to lower the arm into gravity. The elbow extensors and flexors are involved concentrically, in a gravity eliminated plane, to reach far and near pegs. The wrist extensors are used concentrically, against gravity, to raise the pegs, and eccentrically to lower the pegs into gravity. Grasping the pegs with a three-point pinch requires concentric contractions of the thumb, index, and middle finger flexors, and of the thumb abductors and opposer. Releasing the pegs requires concentric contractions of the thumb, index, and middle finger extensors (Lehmkuhl & Smith, 1983). The oculomotor muscles are needed to effect functional visual scanning during the set up and playing of the game. Inability to scan in an organized fashion could interfere with game performance (Warren, 1990).

Sensory Skills

An adult playing this game needs intact kinesthetic and proprioceptive sensations throughout the arm being used in order to properly place the pegs in the board. Tactile sensation could be used in the volar thumb, index, and middle fingers to provide feedback about how much pressure to exert to hold the pegs (Syler, 1988). For persons with poor visual acuity, tactile sensation could also be used to determine the positions of the pegs and holes on the board. Accurate near vision is needed to clearly see the board and the configuration of pegs and holes.

Perceptual Skills

This game taps a number of perceptual skills. Depth perception is needed to judge the relative distances of the pegs and board holes. Figure-ground perception is needed to differentiate the cross area from the rest of the board, the pegs from the board, and the pegs from each other during game play, and to pick one peg at a time out of the box of pegs while setting up the game board. Crossing the midline is important for effective playing of the game, because the center of the board is typically placed at the client's midline. Perception of spatial relations is important to judge the position of the pegs in the board and the possibilities of jumping one peg over another, and motor planning is needed to set up the board for play and to jump pegs over each other during play (Zoltan et al., 1986).

Cognitive Skills

This game also taps multiple cognitive skills. The abilities to attend, concentrate, and conceptually track are necessary for a person to be able to persist and succeed at setting up and playing the game. Initiation and motor persistence are important to begin and continue independently with game set-up and play. Problem-solving, decision-making, organization, and planning skills are all required to play the game successfully, because any given jump can affect the opportunities for further jumps. The ability to follow directions is also important for both setting up and playing the game (Lezak, 1983).

Social Skills

This game is typically played by one person at a time, with cuing and coaching from a therapist. A client playing this game needs to be comfortable with this dyadic coaching situation in which the player's performance is under constant scrutiny. The player needs to accept feedback on his or her performance without getting hostile or defensive, and should also be able to tell the therapist which cues are helpful and which are not. The player also should be assertive enough to ask his or her therapist for assistance when needed.

The game can also be played by two people either cooperatively or competitively. When cooperating, the players work together to determine the best possible moves, with coaching as needed from the therapist. The players need to be able to express their ideas, listen to each other's ideas, and share control of the game without getting hostile or nasty. Both players have to feel comfortable sharing the therapist's attention.

When competing, the players try to execute moves that will be effective in both removing a peg and blocking the opponent's next move, with the therapist coaching both players. The players must be able to compete without getting unduly angry with each other or with the therapist. The players also have to be patient with taking turns (Crepeau, 1986; Mosey, 1973).

Emotional Skills

A person playing this game alone, with therapist coaching, needs to have sufficient impulse control to make
planned instead of random peg movements, and to persist at the game for at least 10 min. The player must be able to receive feedback from the therapist without becoming angry and verbally abusive. The player also needs to stay calm if his or her speed or accuracy with this game is worse than his or her expectations.

A person playing this game in the cooperative situation has to control any urges to dominate the problem-solving process or to belittle the other player’s ideas. In the competitive situation, the players have to be able to accept losing the game without becoming unduly angry or frustrated (Crepeau, 1986; Mosey, 1973).

To establish reasonable expectations for successful performance on this game, the second, third, and fourth authors conducted a small study to assess the speed and accuracy of adults without disabilities. The information from this study can help therapists judge the normalcy of client performance and can also serve as markers by which clients can measure their own success and improvement.

Performance Standards

Subjects

The convenience sample for this performance standards study included 18 people, whose ages ranged from 26 years to 68 years, with no reported history of head injury, stroke, cardiac problems or orthopedic conditions that interfered with hand function. Six of the subjects were men and 12 were women; 17 were right-handed and one was left-handed (see Table 1).

Procedure

Subjects were all tested in their own homes by the second, third, and fourth authors. The board was placed on a table in front of the subject, with 5 in. between the edge of the table and the bottom line of the cross. All subjects were given two trials with the game. The general rules of the game were explained verbally before the first trial. For the first trial, subjects were also told “You are being timed to set the standard or average speed to complete this game. Please go as fast as possible while trying to get rid of the pegs.” For the second trial, subjects were told, “Don’t worry about the time. Just try to get rid of as many pegs as possible.” The trials were planned this way to see whether nondisabled subjects would perform differently under timed and untimed testing conditions, and to assess the mental flexibility of nondisabled subjects in responding to two different sets of directions. For both trials, subjects were not given cues of any kind once the game had begun.

The times and number of pegs left in the board at the end of each game trial were recorded by the examiners. Each subject used his or her dominant hand to play the game.

Table 1 lists the results for each subject for both trials. On the first trial, the times ranged from 38 sec to 2 min 34 sec, with an average of 1 min 17 sec. The number of pegs left in the board at the end of the first trial ranged from 4 to 11, with a median of 5 pegs. These would be the comparison values for a client performing this task for the first time, under time pressure.

For the second trial, the times ranged from 1 min 7 sec to 3 min 25 sec, with an average time of 2 min 5 sec. The number of pegs left in the board at the end of the first trial ranged from 2 to 11, with a median of 5 pegs. These would be the comparison values for a client performing this task after one trial of practice, with no time limits.

In this small nondisabled sample, subjects showed significant improvement in game skill from the first to the second trial. A Wilcoxon matched-pairs signed-rank test on the differences between the number of pegs subjects left in the board on the two trials indicated a significant difference (one-sided p < 0.01), with subjects leaving significantly fewer pegs on the second trial than on the first. Subjects left an average of two fewer pegs in the board on the second trial. This improvement could have been due to a combination of learning and the extra time subjects took on the second trial. (A Wilcoxon matched-pairs signed-rank test on subjects’ time differences between two trials indicated a significant difference [one-sided p < 0.005], with subjects taking significantly more time on the second than on the first trial.) The lack of significant Spearman correlations between time and number of pegs left in either the first (r = 0.02, p > 0.05) or second (r = 0.15, p > 0.05) trials suggests that learning was a factor in the game improvement seen over the

### Table 1

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Note: M = male, F = female.

Subject 7 is left-handed; all other subjects are right-handed.

Results and Discussion

Table 1 lists the results for each subject for both trials. On the first trial, the times ranged from 38 sec to 2 min 34 sec, with an average of 1 min 17 sec. The number of pegs left in the board at the end of the first trial ranged from 4 to 11, with a median of 5 pegs. These would be the comparison values for a client performing this task for the first time, under time pressure.

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two trials. Improvement from the first to the second trial, then, would be the optimal expectation for clients participating in this activity.

The time and peg scores of this pilot sample could be used to assess client skill development during treatment, and to provide motivating feedback for clients on their performance. Skill development is facilitated by the provision of clear performance expectations and feedback (Schwartz, 1985).

Task Grading
This game can be graded from easy to difficult for each of the component skills outlined above. However, we will talk only about grading the motor, sensory, perceptual, and cognitive skill areas because we are presenting this game as a way to improve those skills. We have used this game to retrain motor and sensory skills for adults with hand injuries, and to retrain perceptual and cognitive skills for adults with head injury.

*Motor skills. A therapist could make this game easy motorically for a client by setting up the game before treatment and by encouraging the client to play the game at his or her own pace. The game could be increased in difficulty by requiring the client to set up as well as play the game, by creating time pressure through timing performance, by requiring use of both hands, or by having a client wear wrist weights during game play. Smaller pegs would also require greater dexterity (Seyler, 1988; Trombly, 1989).

*Sensory skills. The smoothness of the pegs requires little tactile discrimination. The tactile demands of this game could be increased in difficulty through use of textured materials taped to the pegs (Seyler, 1988).

*Perceptual skills. Depth perception demands could be lessened or increased by placement of the board closer to or further from the client. Figure–ground perception requirements could be eased by removal of the green pegs from the box. Figure–ground perception requirements could be increased by inclusion of the green pegs, which would not contrast as sharply as the other pegs with the green board (Zoltan et al., 1986). This latter change would be particularly challenging for older clients because the ability to discriminate between greens, blues, and violets decreases with age (Hollander, 1982). Crossing the midline requirements could be reduced if clients were allowed to use both hands, one on either side of the midline during set-up and play. Allowing use of only one hand would increase the demand for crossing the midline. The spatial relations perception demands of this game would be easiest when players used only horizontal and vertical jumps of one peg over another. Spatial relations perception would be more challenged by the inclusion of diagonal jumps and by placement of the board on a diagonal in front of the client, because perception of diagonal orientations is more difficult than perception of vertical or horizontal ones (Ben-Yishay, Diller, Gerstman, & Gordon, 1970; Ben-Yishay, Diller, & Mandleberg, 1970; Royer, Gilmore, & Gruhn, 1984). Motor planning requirements could be reduced if the game were made easier, and increased if the game were made harder (see problem-solving below).

*Cognitive skills. The attention, concentration, conceptual tracking, and direction following requirements of this game could be decreased if the game were set up before treatment and if the client played the game in a quiet room on an uncluttered table. Pegs could be removed from the table by the therapist as the client removed them from the board during play. Therapist cues could be kept to a minimum, to prevent client distraction, and the type of cues given could be the easiest ones for the client to process. For example, if a client responded better to verbal cues than to gestures (e.g., the therapist pointing to a peg that could be jumped), demonstration (e.g., the therapist jumping one peg over another), or hand over hand instruction, then verbal cues would be used to make the activity as easy as possible. Increasing the distraction in the environment and using cues that were more difficult for a client to process would increase the requirements for these component skills.

Initiation requirements could be reduced if the board were set up before treatment and if the client received ongoing cues during game play. Initiation requirements would be increased if the client both set up and played the game, and if therapist input were kept to a minimum during game play.

Problem-solving, decision-making, organization, and planning requirements could be decreased if the game were made easier, (e.g., by leaving one peg out of each arm of the cross, in addition to the one left out of the center). The requirements for these skill components could be increased if the game were made harder (e.g., by limiting game time and by using the two-person situation) (Lezak, 1983).

Qualitative Aspects of Performance
Observations about a client’s approach to a task, the quality of his or her movements, and the types of errors he or she makes can provide valuable information about client strengths and deficits (Milberg, Hebben, & Kaplan, 1986; Trombly, 1989). Several questions can guide the qualitative assessment of clients’ sensorimotor and cognitive-perceptual performances on this activity.

*Is the client focusing on one part of the pegboard more than another while setting up or playing this game? Asymmetrical attention to the different quadrants of the board could indicate difficulties with visual scanning or neglect (Van Deusen, 1988; Warren, 1990).

*Is the client able to cross the midline when necessary to jump and remove pegs? A failure to cross the
midline could indicate difficulties with bilateral integration or neglect (Ayres, 1972; Van Deusen, 1988). Is the client able to attend to the task at hand, or is he or she frequently distracted by visual or auditory stimuli or by his or her thoughts? Observations in response to this question would provide information about the client's attention, concentration and conceptual tracking capacities and might provide specific clues about what types of stimuli are most distracting for a particular client.

Can the client accurately and smoothly place the pegs in the board holes? Difficulty with peg placement could indicate problems in sensation, coordination, or muscle tone. In the absence of motor problems like weakness, ataxia, dysmetria, intention tremor, or incoordination, difficulty in peg placement could suggest problems with motor planning, depth perception, or figure-ground skills.

Does the client require cues to complete the game? The need for ongoing cues could suggest difficulties with attention, concentration, conceptual tracking, or motor persistence. If the client needs ongoing cues, to what type of cues does he or she respond best—visual, verbal, or hand over hand? How repetitive do the cues need to be? Answers to these questions can help therapists structure optimal learning situations for a client across a variety of tasks (Lezak, 1983).

Does the client appear to be using an organized strategy or pattern of approach to the game, or does the removal of pegs look random? A random approach might suggest difficulties with organization, problem solving, or planning. Clients who use some kind of strategy might be able to generalize that strategy to other activities, if the therapist brings the strategy to the level of conscious awareness by pointing it out to the client (Schwartz, 1985, Singer & Cauraugh, 1985). The therapist can also help clients become more aware of their strategies by asking them to explain their approaches to the game (Toglia, 1989). The therapist can then encourage the client to use similar strategies in functional tasks.

Is the client's game score (number of pegs left at the end of play) different in timed versus untimed trials? Clients who have more difficulty in timed trials may have slowed information processing and need extra time to complete functional activities, such as meal preparation, accurately as well. Difficulty in following different directions for the same activity could indicate problems with mental flexibility (Lezak, 1983).

Treatment Goals

The treatment goals for this particular activity could relate to development or sensorimotor or cognitive–perceptual skills, as evidenced by improvement in game play, and to transfer of these skills, as evidenced by improvement in functional activities. Both quantitative and qualitative performance measures could be targeted in game-specific goals. For example, a quantitative goal for an outpatient with cognitive problems secondary to traumatic head injury might be "Client will demonstrate increased problem-solving ability by decreasing the number of pegs left in the board by two in the second of two trials after three half-hour training sessions with the game." This goal sets an expectation that, because of his head injury, this client will learn the game more slowly than adults without disabilities who averaged this same improvement after only one trial. For the same client, a qualitative goal might be "Client will demonstrate increased problem-solving ability by explaining his strategy for game play after three half-hour training sessions with the game." A transfer of training goal might be "Client will demonstrate increased problem-solving ability by independently preparing a hot beverage after three half-hour training sessions with a tabletop board game."

For a client with decreased fine motor coordination secondary to a median nerve injury, a quantitative goal might be "Client will complete game in 2 min 11 sec or less after six half-hour sessions of training with the game." This goal sets the expectation that the client will achieve at least the average speed achieved by the pilot normative sample in their second trial. A qualitative goal for this client might be "Client will complete a game without dropping any pegs after six half-hour sessions of training with the game." The ability to hold onto the pegs would indicate a more normal quality of movement for this client. A transfer of training goal for this client might be "Client will put 12 pieces of cutlery into a dish washer within 5 min without dropping any pieces after six half-hour sessions of training with a tabletop board game."

Conclusion

This paper has presented activity analysis–based suggestions for use of a tabletop board game to improve the cognitive–perceptual and sensorimotor skill components of occupational behavior. The implementation of these suggestions should be tempered by an awareness that repetitive training in any given activity will not automatically promote the generalization of component skills to other activities. Both motor (Poole, 1991) and cognitive–perceptual learning (Neistadt, 1992) are task specific unless attempts are made to teach general motor and perceptual and cognitive strategies during activity practice (Singer & Cauraugh, 1985; Toglia, 1991). Skill generalization is also aided by the use of varied activities in treatment and by variation in individual activities (Toglia, 1991). The exclusive use of a tabletop game like the one described above does not constitute good treatment, no matter how precisely the game might be graded in difficulty. An activity analysis process, like the one modeled above, can help therapists present a variety of treatment activities to clients to help improve relevant skill areas.
The ultimate usefulness of any of these activities, however, needs to be judged by clients' occupational performance, that is, their success in self-care and community living skills. More research is needed to determine how well the activities occupational therapists use in treatment promote functional occupational behavior.

References


