To determine the impact of paediatric TBI and NTBI on families, several studies have underlined the importance of pediatric TBI on families, also after mild or moderate TBI [Hawley, 2003, Wade, 2006] and also after mild or moderate TBI [Hawley, 2003, Wade, 2006] and severe ABI [Anderson, 2005]. Neither studies were found about family impact after NTBI [Hawley, 2003, Wade, 2006].

AIMS:
- To determine the impact of paediatric TBI and NTBI on families in the Netherlands.
- To determine associations between family impact and sociodemographic characteristics, ABI characteristics and current physical and mental functioning.

METHODS:
- Parents of non referred children and youth, with a hospital based diagnosis of ABI made in 2008 or 2009 in 3 major hospitals in the Netherlands.
- Family impact and functioning were measured with the PedsQL FIM: 36 items, measuring parent self-reported functioning. The Total Score is computed as the sum of all 36 items, the Summary Score Parent Health Related Quality of Life (HRQoL) (20 items) and Family Functioning (8 items) and Subscales Communication and Worry were computed. With every item a 5-point response scale is used (0 = never a problem; 4 = almost always a problem).
- To explore the association between the FIM and measures of the patients’ and parents’ health status, linear regression models with the FIM as dependent variable were used.

RESULTS:
- The patients of 108 patients participated in the study (Table 1). The median age of the patients was 13 years (range 6-22), with 60 patients (56%) being male. The cause of ABI was traumatic in 81 patients (75%) and at the time of diagnosis 84 (78%) were classified as mild and 24 (22%) as moderate or severe ABI.
- There was a significant difference between the FIM Total and Parent Health Related Quality of Life Summary Score and Family Functioning Summary scores and the two Subscale Scores Communication and Worry in subgroups of patients with high and low levels (according to the median) for health problems before ABI and type of injury, as well as with almost all measures of functioning at follow-up (Table 2).
- In a multivariable regression analysis the severity and type of injury and the presence of child or family health problems before ABI were found to be associated with lower FIM scores (more family impact).

Table 1. Characteristics of patients with Acquired Brain Injury and their parents in a study on family impact approximately 2 years after onset

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Patient</th>
<th>Parent</th>
<th>Total sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (in years)</td>
<td>13 (6-22)</td>
<td>13 (6-22)</td>
<td>13 (6-22)</td>
</tr>
<tr>
<td>Sex</td>
<td>Male (N=62)</td>
<td>Female (N=46)</td>
<td>Male (N=62)</td>
</tr>
<tr>
<td>Cause of injury</td>
<td>Traumatic (N=81)</td>
<td>Non-traumatic (N=27)</td>
<td>Traumatic (N=81)</td>
</tr>
<tr>
<td>Severe/Minor</td>
<td>Minor (N=39)</td>
<td>Moderate (N=40)</td>
<td>Minor (N=39)</td>
</tr>
<tr>
<td>Severity</td>
<td>Moderate (N=77)</td>
<td>Severe (N=3)</td>
<td>Moderate (N=77)</td>
</tr>
<tr>
<td>Type of injury</td>
<td>Traumatic (N=81)</td>
<td>Non-traumatic (N=27)</td>
<td>Traumatic (N=81)</td>
</tr>
<tr>
<td>Pre-injury physical or mental health problems, number (%)</td>
<td>90 (86)</td>
<td>90 (86)</td>
<td>90 (86)</td>
</tr>
<tr>
<td>Actual physical or mental health problems, number (%)</td>
<td>100 (100)</td>
<td>100 (100)</td>
<td>100 (100)</td>
</tr>
<tr>
<td>Educational level parents, number (%)</td>
<td>Low (N=102)</td>
<td>Intermediate (N=47)</td>
<td>High (N=47)</td>
</tr>
<tr>
<td>Educational level</td>
<td>Low (N=102)</td>
<td>Intermediate (N=47)</td>
<td>High (N=47)</td>
</tr>
<tr>
<td>Family impact predictors</td>
<td>Age at injury</td>
<td>Sex</td>
<td>Cause of injury</td>
</tr>
<tr>
<td>Predictor Variable</td>
<td>Family Impact Total Score</td>
<td>Quality of Life Summary Score</td>
<td>Family Functioning Summary Score</td>
</tr>
<tr>
<td>Age at onset</td>
<td>82.8 (29.9)</td>
<td>76.2 (20.5)</td>
<td>79.8 (20.0)</td>
</tr>
<tr>
<td>Sex</td>
<td>Male (N=62)</td>
<td>Female (N=46)</td>
<td>Male (N=62)</td>
</tr>
<tr>
<td>Cause of injury</td>
<td>Traumatic (N=81)</td>
<td>Non-traumatic (N=27)</td>
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<tr>
<td>Educational level parents, number (%)</td>
<td>Low (N=102)</td>
<td>Intermediate (N=47)</td>
<td>High (N=47)</td>
</tr>
</tbody>
</table>

Table 2. Results of univariable analysis of Total, Summary and Subscale Scores on PedsQL™FIM as dependent variables, related to baseline characteristics at onset (sociodemographic, pre-injury health, injury characteristics) and results at follow-up (actual functioning) approximately 2 years after onset of ABI, as independent or predictor variables

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Total</th>
<th>Summary Scores</th>
<th>Subscale Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Socio-demographic characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at onset</td>
<td>64.9 (17.1)</td>
<td>57.9 (21.9)</td>
<td>60.1 (20.8)</td>
</tr>
<tr>
<td>Sex</td>
<td>Male (N=62)</td>
<td>Female (N=46)</td>
<td>Male (N=62)</td>
</tr>
<tr>
<td>Cause of injury</td>
<td>Traumatic (N=81)</td>
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<tr>
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<tr>
<td>Actual physical or mental health problems, number (%)</td>
<td>100 (100)</td>
<td>100 (100)</td>
<td>100 (100)</td>
</tr>
<tr>
<td>Educational level parents, number (%)</td>
<td>Low (N=102)</td>
<td>Intermediate (N=47)</td>
<td>High (N=47)</td>
</tr>
</tbody>
</table>

CONCLUSION
- Two years after onset, in a hospital based cohort, the impact of ABI on the family as measured by the PedsQL FIM, was considerable.
- The extent of family impact was associated with characteristics of ABI as well as the health status of the child before ABI.

Acknowledgements
This study was financially supported by the Revalidatiefonds, Johanna Kinderfonds and Kinderrevalidatie Fonds Adriaanstichting.

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Wii challenges you

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RELEVANCE
Gaming, especially commercial ‘off the shelf’ consoles, are more and more acknowledged to be promising in therapeutic intervention. Gaming appeals on skills in social-emotional, physical and cognitive areas.

OBJECTIVES
‘Wii challenges you’ is an explorative study to provide insight into the usefulness of the Nintendo Wii to train specific skills of patients within the context of a rehabilitation treatment. The following questions are addressed:
1. Which skills will rehabilitation patients, together with their therapists, choose to improve using the Wii
2. How much time will rehabilitation patients spend playing with the Wii
3. How do therapists experience the use of Wii games in rehabilitation treatment

METHODS
During 10 months, the Nintendo Wii, was used in 3 rehabilitation centres in the Netherlands.
Patients could pre-select from the following skills they would like to improve using the Wii:
- gross and fine motor skills
- perception
- cognition
- communication skills
- participate in social situations
The patients administered a profile with personal goals and a log during the gaming period. After completion of the therapy, or when gamers stopped gaming, the patient and the therapist administered an evaluation.

RESULTS
A total of 42 players (21 men and 21 women aged between 6 and 52 years, (mean 21 years) participated. The medical diagnosis of gamers was very diverse (including traumatic brain injury, stroke, CP, Duchenne muscular dystrophy, spina bifida and spinal cord injury).

1. Personal goals (see tables)
   - In the category gross motor skills patients wanted to improve endurance, balance and strength, in category fine motor skills, eye hand coordination and timing. In cognitive skills they want to train concentration and memory. 21 players administered an evaluation. From the 21 players 12 achieved one or more personal goals.

2. Time
   - The playing time was (46% of the logs) more than half an hour.

3. Experience therapist
   - 33 Therapists filled in the final questionnaire. 85% of the therapists described strong enthusiasm and motivation for training with the Wii in addition to regular therapy, the other 15% scored moderate. Therapists addressed gaming as a potential, additional means to regular therapy. Intensity of and motivation for therapy improved by gaming, as well as the opportunity for practicing at home. 90% of the therapists think the Wii is challenging for patients.

CONCLUSION
Gaming, in addition to therapy, is a promising tool for therapists and patient.

Acknowledgements
We are indebted to the participants and their parents, and to the therapists and teachers who delivered the intervention and performed the assessments. This study was financially supported by the Sponsor Bingo Lottery (HsN090609).
The effect of gaming on different treatment goals of youth with Acquired Brain Injury

Monique A.M. Berger 1, Karen L. van Stein Callenfels 1, Joep Janssen 2, Inge Verhoeven 1, Klaasjan van Haastrecht 1,4, Arend J. de Kloet 1,4

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(3) Delft University, Delft, The Netherlands
(4) Sophia Rehabilitation, The Hague, The Netherlands

RELEVANCE
Gaming, especially commercial ‘off the shelf’ consoles, is increasingly recognized as valuable tool in rehabilitation, in particular for children and adolescents. Gaming in addition to therapy may help e.g. to overcome motivation problems, increase intensity of training and really matches with the daily life and interests of youth. Evidence however is needed to further implement gaming in therapeutic interventions to improve learning and performance of motor skills in patients with ABI.

GOAL
Explorative study on possibilities and effects of gaming (Wii) as a therapy supplement for youth with ABI.

METHODS
• A multicenter, observational proof-of-concept study.
• 50 participants, 12 up to 25 years old, were included in the study.
• The intervention consists of 12 weeks gaming with Nintendo Wii, following a ‘game menu’, individually tuned to self-chosen therapy goals.
• Outcome assessments were done at baseline and after 12 weeks, and included:
  • cognitive functioning measured with subscales of the ANT (Amsterdam Neuropsychological Tasks 1)
  • average number of minutes per week of recreational physical activity
  • self reported results and satisfaction on individual treatment goals (Goal Attainment Scaling, GAS).

RESULTS
45 participants completed the study.
1. Neuropsychological tasks showed significant improvement of speed of information processing: in reaction time, figure identification, shifting attention, visual motor coordination and in response inhibition table 1
   Whereas no significant changes were found regarding accuracy (Table 1)
2. The average number of minutes per week of physical activity increased significantly from 30-60 minutes at baseline to 1-2 hrs (Table 2)
3. 19 participants chose gross motor activities as first treatment goal, in which endurance training and balance was most chosen, 15 of them experienced improvement (GAS); 18 participants chose information processing as first goal, in which concentration and memory were most chosen; 8 of them reported improvement (GAS).

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CONCLUSION
This study underlines the expected benefits of gaming in rehabilitation. Gaming, in addition to therapy, is a promising tool for therapists and patients (www.TherapWii.nl). Research on the effect of gaming on physical and mental functioning should be further explored.

Acknowledgements
We are indebted to the participants and their parents, and to the therapists and teachers who delivered the intervention and performed the assessments. This study was financially supported by the Sponsor Bingo Lottery (HsN090609).

Table 1. Effect of gaming with the Nintendo Wii on neuropsychological functioning of 45 patients with ABI, measured by subscales of the ANT. Results are expressed in median and inter quartile range.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Follow-up</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reaction time</td>
<td>303.0 (84.5)</td>
<td>287.0 (51.5)</td>
<td>.01</td>
</tr>
<tr>
<td>Recognition time</td>
<td>867.5 (361.0)</td>
<td>675.5 (278.3)</td>
<td>.01</td>
</tr>
<tr>
<td>Number of errors</td>
<td>15.0 (15.0)</td>
<td>15.0 (16.9)</td>
<td>.88</td>
</tr>
<tr>
<td>Difference in time</td>
<td>287.0 (302.8)</td>
<td>192.0 (283.0)</td>
<td>.01</td>
</tr>
<tr>
<td>Number of errors</td>
<td>2.0 (4.0)</td>
<td>2.0 (3.0)</td>
<td>.67</td>
</tr>
<tr>
<td>Time dominant hand</td>
<td>1360 (136)</td>
<td>1650 (111)</td>
<td>.047</td>
</tr>
</tbody>
</table>

* p-value of Wilcoxon test, where appropriate

Table 2. Effect of gaming with the Nintendo Wii on the amount of physical activity of 45 patients with ABI. Results are expressed in median and inter quartile range.

<table>
<thead>
<tr>
<th></th>
<th>Baseline (n=50)</th>
<th>Follow-up (n=45)</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical activity</td>
<td>2.0 (2.0)**</td>
<td>3.0 (2.0)**</td>
<td>0.01</td>
</tr>
</tbody>
</table>

* p-value of Wilcoxon test, where appropriate.
**1 = 0-30 minutes, 2 = 30-60 min, 3 = between 1 and 2 hours, 4 = more than 2 hours
The feasibility of a brain game intervention on cognitive recovery after stroke

Manon Wentink 2, Monique A.M. Berger 1, Thea P.M. Vliet Vlieland 2,3,4, Jorit Meesters 2,3, Annemarie Ter Steeg 2, Paulien Goossens 3,4, Guido Band 5, Arend J. de Kloet1 2

INTRODUCTION
• Cognitive impairment is observed in 50% of stroke patients [Paul et al., 2007], and in 32% of patients after 3 years [Patel et al., 2003].
• Recently, a meta-analysis showed that computer-based cognitive rehabilitation is effective in improving attention and visual perception in patients with stroke [Yu-Jin Cha and Hee Kim, 2013].
• Cognitive game training is a promising approach to recovery, but effects on executive control, quality of life, and self-efficacy are unknown. The current study is aimed to fill this gap.

METHODS
• A multicenter randomized controlled trial (RCT).
• Inclusion criteria: a stroke (12-36 months ago), between the age of 45-75 years, self-perceived cognitive impairments, and access to and able to use a computer with internet connection.
• Exclusion criteria: medication for depression, lack of basic computer skill, receiving other interventions for cognitive functions, and severe aphasia and/or sensory integration problems.
• Participants were recruited in two participating rehabilitation centers by first searching in the electronic patient registries for people between 45-75 years old, which were diagnosed with stroke within 12-36 months from September 1, 2012.
• All patients from the database search were invited by letter to participate in the trial by their treating physician. Patients were able to check if they met the inclusion criteria to participate in the trial by a checklist, which was included in the letter. Patients who responded to the letter and willing to participate were screened by the researcher (MW) by telephone to make sure they met the inclusion criteria.

RESULTS
• 889 patients were invited, of whom 146 were willing to participate. 83 patients were excluded. 117 patients were included and randomized. Directly after randomization, five patients refused further participation. 110 patients were present at the first assessment.
• 107 out of 110 participants completed the study (97%), 50 (47%) in the treatment group and 57 (53%) in the control group.
• At baseline, participants in the intervention and control group were similar in characteristics except for more participants with an infarction in the control group than in the intervention group (77% versus 55%), which was a statistically significant difference (p < 0.015).
• 7 from 53 participants in the intervention group failed to play the Lumosity games, due to technical problems with their computer, health problems, and lack of motivation.

Further results are expected soon.

REFERENCES

FUNDING
Financial support for this study was obtained from Fonds Nuts Ohra (grant nr. 2002-006) and Revalidatiefonds (grant nr. 2011-884). Lumosity Inc. provided the computer games for free.

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DISCUSSION
Computer-based cognitive rehabilitation is a promising intervention, since it is a patient-friendly and at the same time inexpensive way of rehabilitation. This study shows that computerized brain training is feasible in patients with CVA. A remarkable high number of patients (97%) completed the study. Further analysis in this study on cognitive functions, quality of life and self-efficacy are expected soon.
Determinants of participation among children and adolescents with Acquired Brain Injury: a systematic review

Arend J. de Kloet, Rianne Gijzen, Lucia W. Braga, Jorit J.L. Meesters, Jan W. Schoones, Thea P.M. Vliet Vlieland

OBJECTIVES
- Participation is considerably restricted in children and adolescents with acquired brain injury (ABI) as compared to their healthy peers.
- This systematic review aims to identify which factors are associated with participation in children and adolescents with ABI.

METHODS
- A systematic search was performed on Medline and various other electronic databases from January 2001 to November 2012.
- All clinical studies that described determinants of participation at least one year after the diagnosis of ABI by means of an outcome instrument in patients up to 18 years of age were included.
- An additional inclusion criterion was needed for comparison and summarization of results: usage of a recommended explicit participation outcome measure, and results on this instrument had to be used in at least 1 analysis.
- Extracted data included study characteristics, patient characteristics, participation outcomes and determinants of participation, impairments of body functions and structures, activity limitations, personal factors and environmental factors.
- The methodological quality of the studies was evaluated based on three quality aspects (selection, information and statistical analysis bias) and scored as low, moderate or high.

RESULTS
- Six papers based on 5 studies using an explicit participation outcome measure were finally selected, for a total of 1172 patients, with follow-up ranging from 1 to 80 months and 2 studies solely including patients with TBI.
- The overall methodological quality of the included 5 studies was moderate.
- Results of 14 studies, finally excluded on use of an implicit participation outcome measure, are reported in Italic (Table 1) as considerations for future research. (Figure 1 associated factors)

CONCLUSION
- This systematic review shows that only a few moderate quality studies on the determinants of participation after ABI using recommended explicit measurement instruments are available.
- A wide range of factors were found to be associated with participation, warranting addressing participation after ABI as a complex and dynamic process.
- More studies are needed to improve understanding of participation (problems) in children and adolescents with ABI and their families, to enable targeted treatment and support for maximizing participation and quality of life, and minimizing secondary problems commonly associated with ABI.
- Future research requires consensus regarding definition of participation and methods of measurement, and should include large cohorts of children and youth in all age groups, types and severity of injury.
- The multi-perspective framework of the International Classification of Functioning, Disability and Health (ICF) offers a scientific base for further research.


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Figure 1. Determinants of more participation problems of children and youth with ABI, found in 5 included and 14 excluded studies as a result of a systematic review and implemented in the ICF-CY model.

Table 1. Study characteristics of 5 included studies, based on explicit participation outcome measures, on determinants of participation after paediatric acquired brain injury; and characteristics of finally excluded studies, based on implicit participation outcome measures.