Is Virtual Reality Effective to Motivate and Raise Interest in Phobic Children Toward Therapy? A Clinical Trial Study of In Vivo With In Virtuo Versus In Vivo Only Treatment Exposure

Julie St-Jacques, PhD; Stéphane Bouchard, PhD; and Claude Bélanger, PhD

Objective: The first objective of this study was to assess if a combined treatment with mostly virtual reality–based (in virtuo) exposure increases phobic children's motivation toward therapy compared to children who only receive in vivo exposure. Another objective was the assessment of motivation as a predictor of treatment outcome.

Method: Thirty-one *DSM-IV*–diagnosed arachnophobic participants aged from 8 to 15 years were randomly assigned to 1 of 2 treatment conditions: in vivo exposure alone or in virtuo plus in vivo exposure. Measures of motivation were taken at pretest and at the end of each part of the treatment; some other measures were taken at each session. The "Why Are You in Therapy?" questionnaire for children was the target measure of motivation and the main variable in the study. Outcome measures were taken at pretest, at the end of each part of the treatment, and at the 6-month follow-up. This study was conducted between September 2006 and March 2007.

Results: The results showed that children who received in virtuo exposure did not show a higher level of motivation toward their treatment than those who received in vivo exposure, but statistically significant interactions were found for both parts of the treatment. Multiple regression analysis confirmed that motivation was a significant predictor of outcome ($P < .01$), especially extrinsic integrated motivation. Participants in the combined treatment were significantly more phobic before beginning treatment, but both treatments appeared successful ($P < .001$).

Conclusions: In this study, the use of virtual reality did not increase motivation toward psychotherapy. At the end of the second part of therapy, all participants were comparably efficient in facing a live tarantula. These results bear important clinical implications concerning how to use virtual reality with children and concerning motivation of children toward therapy in general. They are discussed in the light of how to present in virtuo therapy to children.

Trial Registration: controlled-trials.com Identifier: ISRCTN87716831

J Clin Psychiatry 2010:71(7):924–931

Submitted: *October 26, 2008; accepted August 10, 2009.*
Online ahead of print: *April 6, 2010 (doi:10.4088/JCP.08m04822blu).*
Corresponding author: *Stéphane Bouchard, PhD, Université du Québec en Outaouais, Département de Psychoéducation et de psychologie, CP 1250, Succ Hull, Gatineau, Québec J8X 3X7, Canada (stephane.bouchard@uqo.ca).*

The scientific literature reports that anxiety disorders are the mental disorders most often diagnosed in children and adolescents,[1] and the most common are specific phobia, separation anxiety, and generalized anxiety disorder.[2] In a review of the literature[3] on effective treatments for specific phobia in children, in vivo exposure clearly stands out as a successful approach. However, Öst et al[4] stated that the main reason for treatment failure is participants' lack of motivation.

Degree of motivation appears to be a predictor of therapeutic success,[5] at least with adults. Keijsers[6] suggests that degree of motivation explains 33% of posttreatment gains in adults suffering from specific phobias. Similarly, Öst et al[7] showed that degree of motivation and credibility of therapy were significant predictors for therapeutic gains in a sample of arachnophobic adults.

Motivation can be defined as "a hypothetical construct used to describe the internal and/or external forces that produce the initiation, direction, intensity and persistence of a given behavior."[8(p18)] Theories to explain motivated behavior are both numerous and varied. A theoretical perspective of human motivation that has received much attention over the last decade is the Self-Determination Theory developed by Deci and Ryan,[9] which, according to Vallerand and Thill,[8] could greatly contribute to our understanding of certain issues involved in the efficacy of psychotherapy. It enables clinicians to distinguish between the different types of motivation and their respective impact on how individuals maintain and assimilate therapeutic changes. The types of motivation form a continuum ranging from amotivation—the complete absence of motivation—to intrinsic motivation—the highest form of motivation—with extrinsic motivation falling in between. According to this theory, extrinsic motivation can be further divided into 4 subtypes that range from high to low levels of self-determination: integrated, identified, introjected, and external regulation.

Integrated Regulation

Behaviors that fall under this subtype of extrinsic motivation are expressions of self and are consistent with

the individual's personality and concept of self. An example of integrated regulation would be a child who undergoes therapy to learn extensively about himself (as opposed to intrinsic motivation, in which he would go to therapy for the mere pleasure of the experience).

Preliminary analyses conducted in our laboratory with adults suffering from panic disorder with agoraphobia suggest that highly self-determined extrinsic motivation in the form of integrated regulation is a significant predictor of change. To some extent, this is to be expected in cognitive-behavioral therapy for anxiety disorders, where it is doubtful that intrinsic motivation would be frequent or even healthy (eg, a patient undergoes exposure-based therapy because he enjoys the fact of being *in* therapy).

Identified Regulation

This extrinsic motivation subtype is slightly less self-determined and applies when the child attaches great importance to a given behavior. The internalization of initially external motives becomes sufficient for the person to identify with a given behavior (for example, a child acknowledges the benefits of therapy for her problem and is personally committed to resolving it).

Introjected Regulation

This subtype of extrinsic motivation comes from the person herself and is in the form of pressure or self-esteem–related feelings that she imposes on herself (for example, a child who continues with therapy in order to avoid displeasing or disappointing a parent who believes that therapy will help her).

External Regulation

This is the least self-determined form of extrinsic motivation where behaviors are endorsed solely with the aid of external sources of regulation; behaviors are adopted to respond to environmental contingencies (for example, undergoing therapy to avoid legal complications).

Rapee et al[10] point out that children must be actively stimulated in therapy because, unlike adults, they often lack the ability to think in abstract terms, such as they could get better after the therapy. According to Piaget's cognitive approach,[11,12] children of 6 to 11 years old are at the concrete operational stage of development. Children of that age may have difficulty foreseeing the potential and future benefits related to their therapy. In fact, children tend to perceive things exactly for what they are: when asked to face their fears, which, in itself, is very unpleasant, they will tend to avoid the exercise if they can. Given that way of thinking, it is unlikely that their motivation for exposure-based therapy is intrinsic. We would expect a child undergoing therapy to display motivation located on the continuum of extrinsic motivation, through integrated (the most self-determined extrinsic form of motivation), identified, or introjected regulation.

Because children are often attracted by technology and video games, virtual reality can be a useful tool for sparking their interest in therapy and for maximizing their motivation. The general objective of the present study was to explore the impact of virtual reality on child motivation. Our hypothesis was that children receiving treatment combining virtual reality (in virtuo) with in vivo exposure would show a greater degree of general motivation and a greater degree of integrated regulation. The study's second hypothesis was that motivation would predict therapeutic success. A tertiary and exploratory objective was to determine if virtual reality might be effective in the treatment of arachnophobia.

METHOD

Participants

Participants were recruited through ads in a local newspaper and through leaflets distributed in 8 elementary schools in the Outaouais Valley region. Interested parties were asked to leave a voicemail message. They were then contacted, and 2 preselection interviews took place, 1 with the child's parent(s) and 1 with the child, to confirm the presence of spider phobia as defined in the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition (*DSM-IV*).[13]

Inclusion criteria were that participants had to obtain the consent of their parents or legal custody guardians and had to have received a principal diagnosis of arachnophobia based on the *DSM-IV* criteria.[13] Children who were mentally handicapped or suffering from a major physical disability, epilepsy, disorders of the vestibular system, or otitis media were excluded (these criteria were fixed a priori, but none of the children had such disorders). Furthermore, children suffering from another psychiatric or medical disorder requiring immediate or prerequisite treatment and those taking medication that could block the effect of anxiety (for example, benzodiazepines and serotonin reuptake inhibitors) were excluded and referred to more appropriate services (again, none of the children interviewed were excluded for those reasons). To exclude children who were only slightly phobic, those who obtained a score of 9/10 or 10/10 (n = 3) on the Behavioral Approach Test (BAT, see the Measures section for details) were excluded.

A total of 31 children who met the study's criteria took part in the program. Five were male and 26 were female (no significant differences were found between the 2 genders). Their ages ranged from 8 to 15 years, with a mean age of 10.16 years (SD = 1.59).

To ensure that the therapist's interventions were standardized and consistent in the 2 treatment conditions, all sessions were audio taped. An independent psychologist blind to the children's group status rated the sessions based on a chart designed for the study. Analyses of therapeutic integrity indicated no significant difference between the treatment conditions for 11 of the 13 questions. On 2 items rating the therapist's assistance and directivity during exposure, the rater found that slightly but significantly

more frequent behavior in favor of the in virtuo condition ($F = 16.00$, $P < .05$; $F = 6.00$, $P < .05$, respectively) was noted. This could easily be explained, since the patient cannot see the therapist during in virtuo exposure, which is compensated for with an increase in verbal communication. Despite this slight divergence, the tapes showed that, in essence, the therapist acted comparably in her manner of conducting the in vivo and in virtuo therapy sessions.

Research Protocol

The protocol was approved by the institutional review boards at the hospital and both universities. Parents gave informed consent and youths gave informed assent. After the selection interview, participants were randomly assigned to 1 of the 2 experimental conditions: either 4 sessions of in virtuo exposure followed by 1 session of in vivo exposure (n = 17) or 5 sessions of in vivo exposure (n = 14).

Procedure

The selection began with a brief telephone interview to determine that the participants met the selection criteria. During the interview at the clinic, the parents and children were given the specifics of how the child's treatment would be conducted. They then completed a battery of questionnaires. The BAT was given before the questionnaires to avoid administering tests to a nonphobic child.

Treatment

Information session on specific phobia and the rationale behind the treatment. Using a cognitive-behavioral approach, the therapist explained what a specific phobia is and how it is treated. Information given to the children was adapted to their age group. They received a booklet containing illustrations and exercises that explained the rationale behind the therapy. The children in the combined in virtuo and in vivo exposure group were introduced to the virtual reality system and told of the potential risks associated with using virtual reality, eg, cybersickness.

First phase of the exposure program. The first phase of the exposure program consisted of 4 sessions of in virtuo or in vivo exposure, depending on the participants' condition assignment.

In virtuo exposure. Therapy consisted of four 60-minute sessions over 4 weeks. The participants had to gradually approach virtual spiders (of various sizes and quantity) until their anxiety diminished. The virtual environment was created entirely using an adaptation of the 3D game *Max Payne* (using the game editor, in which violent elements, such as weapons, had been removed). It consisted of 2 apartments composed of a bedroom, living room, kitchen, and bathroom, in which spiders were inserted.

In vivo exposure. In vivo therapy was also provided in four 60-minute sessions. The in vivo participants were confronted gradually at their own pace, starting with pictures of spiders, various plastic spiders, and up to a live tarantula (*Grammostola rosea*, 14 cm long). Like in the in virtuo condition, the discomfort brought on by anxiety was verbally checked every 5 minutes throughout the session.

Second phase of the exposure program. The second phase of the exposure program consisted of 1 in vivo exposure session for all participants. The participants were exposed to the same live tarantula as the one in the BAT (*Grammostola rosea*, 14 cm long). At the end of the in vivo exposure session, an additional period of time was devoted for relapse prevention.

Measures

The diagnosis interview. The *Anxiety Disorders Interview Schedule for DSM-IV: Child and Parent Version*[14] was used to assess the presence of spider phobia and comorbid disorders. The participants and their parents took part in separate semistructured interviews aimed at detecting anxiety disorders in the children. Studies conducted on these instruments suggest a high interrater reliability ($r = 0.98$ for interviews with parents and $r = 0.93$ for interviews with children[15]) and high test-retest reliability ($\kappa = 0.76$ for interviews with parents[16]).

Questionnaires and behavioral measure. The first 4 instruments dealt with motivation, interest, and participant's perception of the therapy program. The last measure of motivation was designed for the current study and administered beforehand to an independent sample of 31 school-aged children to ensure they understood the items. Measurement times are indicated as follows: T1 = pretreatment; T2 = information session; T3 = mean of the scores collected weekly during the first phase of the treatment; T4 = post–phase 1; T5 = posttreatment; T6 = 6-month follow-up.

Measures of motivation and interest toward treatment. The "Why Are You in Therapy?" Questionnaire for children was administered (French translation by Pelletier and Green-Demers, 2002, available from the authors on request).[17] This was the target measure of motivation and the main variable in this study. It assesses the type of motivation shown by patients in therapy, as defined by Deci and Ryan.[9] To shorten the questionnaire from 24 to 17 items, we retained only the 2 items with the highest saturation on each subscale. The rating ranges from 1 to 5 on a Likert-type scale ranging from "not at all" to "absolutely." Participants had to fill out the questionnaire at pretreatment (T1), post–phase 1 (T4), and posttreatment (T5).

The Treatment-Related Discomfort Questionnaire consisted of 4 items designed to assess signs of reluctance to come to therapy. The parents had to indicate to what extent they were in agreement with the statements describing their children's emotions and behaviors before coming to each therapy session in the 2 phases of the treatment program (T3 and T5). The choices of responses were from 1 to 7 on a Likert-type scale ranging from "does not correspond at all" to "corresponds completely" and were averaged to produce the final score.

Measures of treatment outcome. A shortened version of the Spider Phobia Beliefs Questionnaire[18] was used. The 23

Table 1. Descriptive Data for Total Score and Subscale Scores of the Measure of Motivation in 31 Children With Arachnophobia Treated With In Vivo and In Virtuo Exposure to Spiders

Motivation	Pretreatment (T1), Mean (SD)	Post–Phase 1 (T4), Mean (SD)	Posttreatment (T5), Mean (SD)
Total			
In vivo	5.67 (1.43)	6.43 (1.69)	6.58 (2.03)
In virtuo	5.32 (1.80)	4.99 (1.69)	6.39 (2.40)
Intrinsic motivation			
In vivo	20.29 (7.61)	18.00 (7.72)	19.24 (8.94)
In virtuo	19.71 (7.42)	14.57 (6.95)	18.64 (8.74)
Extrinsic motivation (integrated regulation subscale)			
In vivo	12.71 (3.74)	19.35 (5.16)	16.94 (5.06)
In virtuo	12.00 (5.08)	13.14 (6.26)	19.86 (7.54)

items with the strongest loadings on both subscales (beliefs about spiders and beliefs about oneself in the presence of a spider) were retained. The measure was administered at pretreatment (T1), post–phase 1 (T4), posttreatment (T5), and at the 6-month follow-up (T6).

The Spider Phobia Questionnaire for Children[19] was administered at pretreatment (T1), after phase 1 of the treatment (T4), at the end of the treatment program (T5), and at the 6-month follow-up (T6). The instrument contains 29 items that measure the severity of fear of spiders and avoidance behaviors using a dichotomous true-false format.

The BAT was used.[20] This test was adapted from a study by Lavy and collegues[21] and provides an objective of phobic avoidance. The BAT was administered at pretreatment (T1), post–phase 1 (T4), and posttreatment (T5). A live tarantula was put in a closed vivarium on a motorized platform placed on a table, 173 cm from the participant. The child could move the vivarium closer in by pushing a button at his/her own pace. The BAT score varied from 0 (refuse to perform the test) to 10 (the strongest approach behavior), and the last step the child was able to complete provided the score.[20]

Measures relating to use of the virtual reality. The following 3 ancillary measures were administered to describe the sample using questionnaires that are important to measure in virtual reality studies. The Immersion Tendencies Questionnaire[22] was administered at pretreatment (T1) in order to describe the sample and the extent to which the child could easily feel immersed in the virtual environment. It consists of 34 questions on a 7-point Likert-type scale (from 1-never to 7-often). The 19-item Child Presence Questionnaire[20] measured the extent of the child's feeling of being "there" in the virtual environment, a variable considered a prerequisite to emotionally react when immersed in a virtual environment.[22] Finally, an 11-item Cybersickness Questionnaire[20] measured the extent to which the children were affected by side effects induced by their immersion in virtual reality (nausea, eye fatigue, dizziness, etc) and was administered after each therapy session in virtual reality (mean of the scores collected during the first phase of the treatment, T3). Results regarding these instruments revealed that the immersive tendency and feeling of presence were adequate, and little cybersickness was reported (detailed results regarding these instruments are available upon request).

Hardware

The material used for the immersion in the virtual reality was composed of the following equipment: a Pentium IV computer (3.20 GHz, 2.00 GB of RAM; Intel, Santa Clara, California), a GeForce FX 5900 XT graphics card (NVIDIA, Santa Clara, California), modified *Max Payne* 3D scenes,[21] an nVisor SX head-mounted display (1280 × 1024/eye resolution; 60° diagonal field-of-view; NVIS, Reston, Virginia), an InertiaCube-2 Pro orientation tracker (3 DOF; InterSense, Billerica, Massachusetts), and a Microsoft Gyration wireless mouse (Microsoft, Redmond, Washington).

Data Analysis

Two types of statistics were used to analyze the results: 2 × 2, 2 × 3, and 2 × 5 repeated-measures analyses of variance (ANOVAs; effect sizes and interaction contrasts are reported when necessary) and multiple regressions. Before conducting the initial analyses, attention was devoted to confirm that the assumptions of each statistical analysis were met.[23]

RESULTS

Main Hypothesis—Motivation Measures

The results on the target measure of motivation show no significant difference between the 2 conditions for the total score (Tables 1 and 2). Effect-size analysis (Cohen $f = 0.22$) indicated that it would have taken a sample of over 200 participants to obtain an 80% chance of observing a significant difference in main effect for motivation.

The results obtained for integrated regulation of the target measure of motivation (see Tables 1 and 2) show no significant difference between the 2 treatment conditions. Effect-size analysis (Cohen $f = 0.23$) indicates that a sample of approximately 130 participants would have been necessary to have an 80% chance of obtaining a significant main effect. However, the data reveal that the time × condition interaction is significant during both treatment phases. Integrated regulation is significantly higher at post–phase 1 for participants in the in vivo condition, whereas children in the in virtuo group were more motivated at posttreatment.

Reluctance to come to therapy, as assessed by the participants' parents, was moderate, stable ($F = 0.08$, not

Table 2. Repeated-Measures Analysis of Variance Results for Subscales of the Measure of Motivation (N = 31)

	Main Effect					Contrasts[a]			
						Time		Interaction	
Motivation	Condition (df = 1,29)	η^2	Time (df = 1,29)	η^2	Time × Condition Interaction	T1 vs T4	T4 vs T5	T1 vs T4	T4 vs T5
Total	1.39	0.05	5.40**	0.16	2.34	0.54	4.96*	3.62	3.28
Intrinsic motivation	0.38	0.01	4.79**	0.14	0.88	8.56**	4.93*	1.26	1.41
Extrinsic motivation (integrated regulation subscale)	0.73	0.03	16.31**	0.36	9.17**	14.08**	3.38	7.03**	15.21**

[a]T1 = pretreatment, T4 = post–phase 1, T5 = posttreatment.
*P < .05.
**P < .01.

Table 3. Multiple Regression for the Predictive Value of the Motivation Subscales on Treatment Outcome (residualized change score on the Spider Phobia Questionnaire for Children) (N = 31)

Measures	Standardized Coefficient, β (SD)	Unstandardized Coefficient, β	t	Unique Variance, sr^2
Spider Phobia Questionnaire for Children	0.47 (0.14)	0.53	3.46**	0.45
Motivation subscales				
Intrinsic	−0.07 (0.09)	−0.12	−0.80	−0.11
Integrated regulation	−0.43 (0.15)	−0.41	−2.93**	−0.38
Identified regulation	0.58 (0.46)	0.22	1.27	0.17
Introjected regulation	0.07 (0.39)	0.03	0.18	0.02
External regulation	−0.23 (0.21)	−0.19	−1.06	−0.14
Amotivation	−0.54 (0.27)	−0.29	−2.03	−0.27

*P < .05.
**P < .01.

significant), and similar in both conditions (F = 0.66, not significant). The effect size was small (Cohen f = 0.15) for the time × condition interaction, suggesting it would have taken over 300 participants to have an 80% chance of detecting a significant change.

Secondary Hypothesis—Measures Relating to the Predictive Value of Motivation

To explore the potential role that motivation plays in the improvement of the participants, multiple regression analyses were performed using residualized change scores.[24] All the regression equations attempted to predict the fear of spiders score at posttreatment using the pretreatment scores obtained on the fear of spiders measure of the Spider Phobia Questionnaire for Children and the other predictive variables. In the first regression, all motivation subscales of the target measure of motivation were entered simultaneously as a set of predictive variables. A regression was also conducted with the integrated extrinsic motivation subscale only, and the results were similar. The multiple regression predicting changes on the Spider Phobia Questionnaire for Children (residual score) using all subscales of the target measure of motivation was found to be significant ($F_{7,30}$ = 5.03, P < .001) and explained 60.5% of the variance (adjusted R^2 = 0.49). Table 3 illustrates the contribution of each motivation subscale to the regression equation and shows that the only significant parameter was integrated regulation.

Given the known predictive power of changes in beliefs on treatment outcome,[5] an exploratory regression was performed by simultaneously entering the integrated regulation scale and pretreatment and posttreatment scores on the Spider Phobia Beliefs Questionnaire[18] as predictive variables. The standard multiple regression was significant ($F_{4,30}$ = 9.47, P < .001; R^2 = 0.59; R^2 adjusted = 0.53), and both motivation (β = −0.39, t = −3.13, P < .01, sr^2 = −0.39) and changes in beliefs (β = 0.35, t = 2.67, P < .05, sr^2 = .33) were significant parameters. To compare the predictive power of motivation and beliefs, 2 hierarchical regressions were conducted. In the first hierarchical regression, residualized change score for the Spider Phobia Beliefs Questionnaire was entered first as a predictive variable, followed by the integrated regulation subscale. The significance level associated with the addition of the second variable tells us whether it contributed to the prediction equation after controlling for changes in beliefs. The second hierarchical regression was then conducted by first entering the Spider Phobia Beliefs Questionnaire and the integrated regulation subscale as predictive variables, followed by residualized change score for spider beliefs. The significance level associated with the addition of the second variable then tells us whether it contributed to the prediction equation after controlling for motivation. Both hierarchical regressions showed that integrated regulation and change in beliefs significantly contributed over and above the variance explained by each other ($F_{26,1}$ change = 9.79, P < .01; $F_{26,1}$ change = 7.1, P < .05, respectively).

Exploratory Analyses for Treatment Outcome

To explore the relative efficacy of the 2 forms of therapy, 2 × 4 repeated-measures ANOVAs were used. Two participants did not complete the outcome measures at the 6-month follow-up, and an intent-to-treat approach was used, with last available data being carried forward used to compensate for the 2 missing participants. A more conservative F ratio (Huyn-Feldt adjusted F) was also used. To document the impact of the differences observed, effect

Table 4. Descriptive Data for the Outcome Measures (N = 31)

Questionnaire	Pretreatment (T1), Mean (SD)	Post–Phase 1 (T4), Mean (SD)	Posttreatment (T5), Mean (SD)	6-Month Follow-Up (T6), Mean (SD)
Spider Phobia				
In vivo	15.82 (5.46)	11.71 (5.62)	10.53 (4.56)	8.29 (4.74)
In virtuo	17.79 (4.46)	14.21 (5.52)	10.50 (4.69)	8.57 (8.42)
Spider Phobia Beliefs Questionnaire—behaviors of spiders				
In vivo	14.24 (7.56)	11.29 (5.68)	10.53 (4.67)	7.82 (3.85)
In virtuo	14.64 (3.57)	12.36 (4.73)	9.29 (3.41)	7.57 (7.71)
Spider Phobia Beliefs Questionnaire—one's own behaviors				
In vivo	10.18 (4.11)	7.18 (3.66)	5.65 (3.76)	5.24 (3.46)
In virtuo	10.29 (3.91)	9.07 (3.83)	6.57 (4.59)	4.86 (4.04)
Behavioral Approach Test				
In vivo	3.29 (2.49)	7.06 (3.83)	9.71 (0.69)	…
In virtuo	1.57 (2.17)	4.21 (3.32)	9.71 (1.07)	…

Symbol: … = not applicable.

Table 5. Repeated-Measures Analysis of Variance Results for the Outcome Measures (N = 31)

	Main Effect				Interaction	Contrasts[a]					
						Time			Interaction		
Questionnaire	Condition	η^2	Time	η^2	Time × Condition	T1 vs T4	T4 vs T5	T5 vs T6	T1 vs T4	T4 vs T5	T5 vs T6
Spider Phobia	0.63	0.02	36.11**	0.56	1.08	19.73**	14.11**	6.87**	0.10	3.80	0.04
Spider Phobia Beliefs Questionnaire—behaviors of spiders	0.00	0.00	18.02**	0.38	0.53	8.45**	6.53**	8.95**	0.13	2.36	0.45
Spider Phobia Beliefs Questionnaire—one's own behaviors	0.30	0.01	23.87**	0.45	1.13	12.12**	16.76**	2.80	2.18	0.97	1.05
Behavioral Approach Test	5.28	0.15	90.96**	0.76	3.53*	32.62**	45.14**	…	1.00	5.54**	…

[a]T1 = pretreatment, T4 = post–phase 1, T5 = posttreatment, T6 = 6-month follow-up.
*$P < .05$.
**$P < .01$.
Symbol: … = not applicable.

sizes[24,25] were calculated. Given that participants in the in virtuo group proved to be more severely phobic after random assignment, analyses of covariance were also performed and confirmed all findings. Lastly, to reduce the risk of type I errors, Bonferonni corrections were applied, and the significance level was set at .01.

Repeated-measures ANOVAs performed on the results of the Spider Phobia Questionnaire for Children showed no significant differences between the 2 conditions (Tables 4 and 5). Participants in both groups reported a significant decrease in fear, with significant differences between pretreatment and post–phase 1, between post–phase 1 and posttreatment, and between posttreatment and the follow-up. However, effect size ($\eta^2 = 0.116$; Cohen $f = 0.36$) for the time × condition interaction suggested that with approximately twice the current sample size (35 participants per group), we would have obtained an 80% chance that the in virtuo participants would present a significantly greater decrease in their fear of spiders between post–phase 1 and posttreatment.

The results on the Spider Phobia Beliefs Questionnaire show significant improvement in both conditions. The BAT indicates marked progress at posttreatment (see Tables 4 and 5). However, a difference between the 2 conditions can be noted at pretreatment. Overall, participants in the in virtuo condition progressed just as quickly as the in vivo participants during the first phase of treatment and caught up with the other group between post–phase 1 and posttreatment.

DISCUSSION

The main objective of the present study was to determine if motivation differed among arachnophobic children receiving treatment combining virtual reality and in vivo exposure from those receiving treatment involving only in vivo exposure. A second goal was to examine whether motivation could be a predictor of therapeutic success.

Overall, the study revealed that children in the in virtuo condition were neither more nor less motivated about their treatment than children in the in vivo condition, thus refuting the main hypothesis of the study. Compared to participants in the in vivo condition, in virtuo participants did not show greater general motivation or the extrinsic but highly self-determined integrated regulation. It is interesting to note, however, that the time × condition result was significant for integrated regulation, implying an increase in motivation for participants in the in virtuo condition and a decrease for in vivo participants.

Why were the results different from what we expected? A posttherapy discussion with the children provided some potential explanations. In addition to the fact that participants

© COPYRIGHT 2010 PHYSICIANS POSTGRADUATE PRESS, INC.

in the in virtuo condition were more severely phobic, some participants in the in vivo condition reported they were afraid of virtual reality (which they had never tried). They had the impression they would feel "stuck" in the headset, without being able to remove it if the situation proved to be too frightening. The virtual environment caused a certain amount of fear with many of the children in the in vivo condition, thinking they would be seeing something as "scary as a horror movie." These findings are contrary to the results obtained by Garcia-Palacios and colleagues,[26] who showed that the rate of treatment refusal was higher for participants if the treatment involved in vivo rather than in virtuo exposure. The discrepancy with our results may be because they interviewed adults. For example, many of the parents of our participants said they were attracted by the publicity about the treatment because it involved virtual reality. But what about the children's perceptions? Is virtual reality more frightening to them? This could concur with the findings of Jessie[27] to the effect that parents of children who undergo therapy tend to perceive the treatment more positively than their children. Jessie's study[27] highlighted that children often do not have the ability to think in terms of abstractions or to project themselves into the future, and, thus, we should not assume that they would understand the subtleties of a treatment that would be obvious to adults. For example, the fact that an adult perceives virtual reality as being less threatening because it does not involve real spiders does not mean that children will arrive at the same conclusions on their own. Also, because of their imagination, the children may be more frightened than reassured by virtual spiders.

The present study revealed that motivation—more specifically, integrated regulation—plays an important role in treatment outcome, over and above change in dysfunctional beliefs. This is a significant finding, since very few studies on cognitive-behavioral therapy paid attention to motivation, even less to subtypes of motivation. Because of this lack of previous research with anxiety disorders, we do not have sufficient information to make detailed recommendations. To improve treatment efficacy, future studies should focus on factors that influence motivation to come and stay in therapy.

In addition to assessing motivation, the present study tentatively explored the efficacy of 2 treatment methods. The results of questionnaires and the BAT show a marked improvement, which concurs with findings of previous studies on the efficacy of short treatment programs for the same types of population and disorder.[28,29] Effect size analyses suggest, however, that in virtuo exposure alone is perhaps not as effective in treating spider phobia as conventional in vivo exposure. While treatment involving only virtual reality appears to be sufficient for phobic adults,[20] it would appear that the same does not hold true for children. Adding an in vivo exposure session to the in virtuo condition was needed to reach the same score on the BAT as the in vivo participants. As for the data obtained for treatment efficacy, our observations must be treated with caution: despite the fact that the children were randomly assigned the conditions, the BAT data indicate that the children in the in virtuo group were more severely phobic from the outset. The lack of a control condition also precludes reaching any firm conclusion regarding these exploratory analyses.

Certain clinical implications can be derived from the current study. One is that presenting virtual reality as a treatment tool for children should take into account their age, in order to ensure, for example, that the children are not unduly frightened about the treatment. A brief outline of the treatment and the behavior of the virtual spiders could perhaps be given to them. Sustained parental involvement might be a factor that encourages children to commit to and continue with therapy. It might be interesting to involve the parents more, informing them with more details about their children's progress, and have them involved in the various steps of the therapy program to boost their impact on motivation.

In conclusion, more research is needed on the role of motivation in the cognitive-behavioral therapy of anxiety disorders in children. Clinicians would benefit from solutions aimed at increasing young people's motivation toward therapy. Further studies need to replicate our findings about motivation being a significant and important predictor of treatment success, with the ultimate objective of proposing a theoretical model that could shed light on factors involved in motivating children to come to and stay in therapy.

Author affiliations: Université du Québec à Montréal (Drs St-Jacques and Bélanger); Université du Québec en Outaouais (UQO) (Dr Bouchard); and Université McGill and Research Center, Douglas Hospital (Dr Bélanger).
Author contributions: The study was conducted at the Laboratoire de Cyberpsychologie de l'UQO (http://w3.uqo.ca/cyberpsy), where the first author was completing her Ph.D. She is now affiliated to the Centre Hospitalier Pierre-Janet. This article is part of her doctoral dissertation.
Potential conflicts of interest: None reported.
Funding/support: This article was funded in part by research grants from the Canada Research Chairs program and the Canada Foundation for Innovation.

REFERENCES

1. Albano AM, Chorpita B, Barlow DH. Childhood anxiety disorders. In: Mash EJ, Barkley RA, eds. *Child Psychopathology*. 2nd ed. New York, NY: Guilford Press; 2003.
2. Ollendick TH, King NJ. Empirically supported treatments for children with phobic and anxiety disorders: current status. *J Clin Child Psychol*. 1998;27(2):156–167.
3. St-Jacques J, Bouchard S, Bélanger C. La phobie spécifique chez l'enfant et l'adolescent: recension des écrits sur les traitements utilisant l'exposition. *Counselling and Spirituality*. 2008;27(1):71–88.
4. Öst L-G, Svensson L, Hellström K, et al. One-session treatment of specific phobias in youths: a randomized clinical trial. *J Consult Clin Psychol*. 2001;69(5):814–824.
5. Beck AT. Cognitive therapy: a sign of retrogression or progress. *Behav Therapist*. 1986;9(1):2–3.
6. Keijsers G. *Prognostic Factors in the Treatment of Anxiety and Failure in Behaviour Therapy* [dissertation]. Nijmegen, Holland: Radboud Universiteit Nijmegen; 1994.
7. Öst L-G, Stridh B-M, Wolf M. A clinical study of spider phobia: prediction of outcome after self-help and therapist-directed treatments. *Behav Res Ther*. 1998;36(1):17–35.
8. Vallerand RJ, Thill EE. Introduction au concept de motivation. In: Vallerand RJ, Thill EE. *Introduction à la psychologie de la motivation*.

Laval, Québec: Éditions Études Vivantes;1993:5–39.
9. Deci EL, Ryan RM. *Intrinsic Motivation and Self-Determination in Human Behavior*. New York, NY: Plenum Press; 1985.
10. Rapee RM, Wignall A, Hudson JL, et al. *Treating Anxious Children and Adolescents: An Evidence-Based Approach*. Oakland, CA: New Harbinger Publications, Inc; 2000.
11. Piaget J. *The Child's Conception of Movement and Speed*. Holloway GET, Mackenzie MJ (trans). New York, NY: Basic Books; 1970.
12. Berger KS. *Psychologie du développement*. Des Lierres MR, trans. Mont-Royal, Québec: Modulo Éditeur; 2000.
13. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition. Washington: American Psychiatric Association; 1994.
14. Silverman W, Albano AM. *The Anxiety Disorders Schedule for Children (DSM-IV)*. San Antonio, TX: Psychological Corporation; 1997.
15. Silverman WK, Nelles WB. The Anxiety Disorders Interview Schedule for Children. *J Am Acad Child Adolesc Psychiatry*. 1988;27(6):772–778.
16. Silverman WK, Eisen AR. Age differences in the reliability of parent and child reports of child anxious symptomatology using a structured interview. *J Am Acad Child Adolesc Psychiatry*. 1992;31(1):117–124.
17. Pelletier LG, Tuson KM, Haddad NK. Client Motivation for Therapy Scale: a measure of intrinsic motivation, extrinsic motivation, and amotivation for therapy. *J Pers Assess*. 1997;68(2):414–435.
18. Arntz A, Lavy E, van der Berg G, et al. Negative beliefs of spider phobics: a psychometric evaluation of the Spider Phobia Beliefs Questionnaire. *Adv Behav Res Ther*. 1993;15(4):257–277.
19. Kindt M, Brosschot JF, Muris P. Spider Phobia Questionnaire for Children (SPQ-C): a psychometric study and normative data. *Behav Res Ther*. 1996;34(3):277–282.
20. Côté S, Bouchard S. Documenting the efficacy of virtual reality exposure with psychophysiological and information processing measures. *Appl Psychophysiol Biofeedback*. 2005;30(3):217–232.
21. Lavy E, van den Hout M, Arntz A. Attentional bias and spider phobia: conceptual and clinical issues. *Behav Res Ther*. 1993;31(1):17–24.
22. Witmer B, Singer M. Measuring presence in virtual environments: a presence questionnaire. *Presence*. 1998;7(3):225–240.
23. Tabachnick BG, Fidell LS. *Using Multivariate Statistics*. 4th ed. Boston, MA: Allyn and Bacon; 2001.
24. Cohen J, Cohen P. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. 2nd ed. Hillsdale, NJ: L. Erlbaum Associates; 1983.
25. Cohen J. *Statistical Power Analysis for the Behavioral Sciences*. 2nd ed. Hillsdale, NJ: Lawrence Erlbaum Associates; 1988.
26. Garcia-Palacios A, Hoffman HG, See SK, et al. Redefining therapeutic success with virtual reality exposure therapy. *Cyberpsychol Behav*. 2001; 4(3):341–348.
27. Jessie KA. *Children's and parents' perceptions of treatment acceptability and treatment response to components of a day treatment program* [dissertation]. *Dissertation Abstract International*. 1999;59(9b):5088.
28. Muris P, Merckelbach H, Holdrinet I, et al. Treating phobic children: effects of EMDR versus exposure. *J Clin Child Psychol*. 1998;66(1): 193–198.
29. Bouchard S, Côté S, St-Jacques J, et al. Effectiveness of virtual reality exposure in the treatment of arachnophobia using 3D games. *Technol Health Care*. 2006;14(1):19–27.

Editor's Note: We encourage authors to submit papers for consideration as a part of our Focus on Childhood and Adolescent Mental Health section. Please contact Karen D. Wagner, MD, PhD, at kwagner@psychiatrist.com.