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Exploring expectations for upper extremity motor treatment in people after stroke: A secondary analysis

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Abstract

Objective—Our purpose was to explore expectations for outcomes during a research intervention for people with stroke.

Methods—Twelve people with chronic stroke participated in this secondary analysis from a pilot trial of a high repetition, task-specific, upper extremity intervention. First, we examined relationships between individual expectancy and session-by-session achievement of high numbers of repetitions. Second, we examined the relationship between expectancy for the intervention as a whole and improvements in upper extremity motor function. Spearman rank correlation coefficients were used to evaluate the relationships.

Results—Correlations between individual expectancy and session-by-session achievement ranged from 0.0 to 0.84. Expectancy for improvement from the intervention was good (ave. = 7/10), but had a low correlation (0.17) with actual improvement.

Conclusions—Individual expectancy ratings were inconsistently related to session-by-session achievement. Expectancy for the intervention as a whole was not related to improvement in upper extremity motor function.

MeSH terms

recovery; rehabilitation; occupational therapy; upper extremity; Questionnaires

Introduction

Outcome expectancy is the individual's expectations for a successful rehabilitation outcome, assuming he/she makes the required effort (Geelen & Soons, 1996). Expectancy has been found to be an important predictor of outcomes in people with psychiatric conditions (Collins & Hyer, 1986; G.J. Devilly & Borkovec, 2000; G. J. Devilly & Spence, 1999), people with low back pain (Smeets, et al., 2008), and geriatric individuals in inpatient rehabilitation facilities (Resnick, 1998). Furthermore, expectancy is also related to positive exercise behavior in older adults (Resnick, 2001). This emerging body of research suggests that people with higher expectations may receive more benefit from treatment than people with lower expectations. In our literature search we found no studies investigating outcome expectations and subsequent recovery of function for people with stroke. Based on the

heterogeneous populations cited above however, it is plausible that a person's expectancy would be an important factor in recovery of function after stroke as well.

Stroke is the leading cause of disability in the western world. Eighty percent of stroke survivors will experience hemiparesis early after stroke (Barker & Mullooly, 1997). Roughly 50% of individuals will need assistance with activities of daily living 6 months post stroke (Legg, et al., 2007). Recovery from stroke is a long process taking between 6 and 20 weeks for an individual to reach his/her best ADL function (Jorgensen, et al., 1995). Given the less than ideal outcomes from stroke, and the length of stroke recovery, it is important to explore outcome expectations in people with stroke specifically. Expectations of the client are an important feature of client-centered care. Systematically assessing each individual's expectations could foster better communication during the course of therapy services. Additionally, clinicians working with individuals post-stroke may want to consider the individual's outcome expectations when choosing specific interventions or planning treatment sessions.

We recently conducted a proof-of-concept study to improve upper extremity motor function in people with chronic stroke. Our goal was to translate the high repetition doses of task-specific training experienced by animal models to people with stroke (Birkenmeier, Prager, & Lang, in press). While animal models of stroke experience hundreds of daily repetitions of task specific upper extremity training (Kleim, Barbay, & Nudo, 1998; Nudo, Milliken, Jenkins, & Merzenich, 1996; Nudo, Wise, SiFuentes, & Milliken, 1996), people with stroke experience little or no task specific upper extremity training during rehabilitation (Lang, MacDonald, & Gnip, 2007; Lang, et al., 2009). In our study, people with stroke were encouraged to achieve ≥ 300 repetitions of task specific upper extremity training within one-hour therapy sessions in an effort to improve the functional use of their affected upper extremity. We reasoned this high number of repetitions might be feasible if the therapist and subject were engaged, the task and task difficulty were carefully selected, and the environment was appropriately arranged. Understanding how expectancy influences the ability to achieve high numbers of repetitions and the ability to improve upper extremity motor function will assist in the process of translating this intervention to people with stroke.

The purpose of this paper was to explore the relationship between expectancy and two key outcomes of this intervention: individual session-by-session repetition achievement and overall improvement in upper extremity motor function. First, we measured subjects' expectancy for reaching the target numbers of repetitions each treatment session. Our research question was: will individuals with higher expectancy ratings achieve more repetitions per therapy session than individuals with lower expectancy ratings? Second, we measured expectancy for improvement in upper extremity motor function by the end of the intervention. Our research question was: will individuals with higher expectations show greater improvements in upper extremity motor function than individuals with lower expectations? These pilot data can contribute to the emerging body of knowledge on the relationship between peoples' expectations and outcomes.

Methods

This investigation into expectancy was part of a high repetition dose study in which 12 subjects attempted to complete ≥ 300 repetitions of task-specific upper extremity training in one hour therapy sessions (Birkenmeier, et al. in press). This study was a within-subjects, repeated measures, cohort design. The study began with baseline visits, one per week for three weeks, followed by the 6 week intervention (3 sessions/week = 18 total sessions). Post intervention assessments occurred at the end of the intervention and one month later.

Intervention Specifics

Primary methods and results from the high repetitions intervention are detailed in another report (see Birkenmeier et al., for details). Here, we briefly outline the intervention protocol. The high repetition intervention consisted of supervised, whole-task, massed practice of functional daily tasks which were appropriately graded and progressed for each subject. An occupational or physical therapist, or supervised occupational therapy student delivered the intervention in one hour treatment sessions. Subjects were given the Canadian Occupational Performance Measure (COPM) to assist in determining activities of interest and specific tasks to address during treatment sessions (Law, et al., 1990). An individualized approach to task selection (Higgins, et al., 2006) and not a general one (all subjects do the same tasks), was selected because severity of paresis and personal interests vary across people with stroke. Additionally, being given a choice of tasks may enhance motivation and participation in rehabilitation (Patten, Dozono, Schmidt, Jue, & Lum, 2006; Salbach, et al., 2004). Three tasks per session (≥ 100 repetitions per task) were selected to allow for variability in task practice and to avoid the boredom that might come from performing ≥ 300 repetitions of a single task.

Using information from the baseline assessments, selected tasks were graded to match the motor capabilities of the subject. The job of the therapist was to grade tasks such that they challenged, but not over- or underwhelmed, the motor capabilities of each subject. An example of a frequently used task was “lifting cans on shelves”. This task simulated the real world activity of storing and retrieving objects on shelves, such as putting away groceries. This task could be graded by: 1) changing the size, weight, or shape of the cans; 2) changing the height of the shelf; 3) changing the location of the shelves with respect to the subject; and/or 4) changing the depth of the cans on the shelves. Other frequently used tasks were: “writing,” “folding towels,” and “managing and manipulating coins.” Appropriate tasks were chosen based on patient goals and hand dominance. All tasks, bilateral and unilateral, were designed to challenge the impaired upper extremity. Algorithms were developed to determine when to progress a task, i.e. grade up or grade down, and when to switch tasks.

Subjects

Twenty-seven subjects were screened and 15 were enrolled in the repetitions study. Twelve of the 15 subjects provided expectancy data for this report. Two subjects did not provide expectancy data because they were enrolled prior to finalizing the expectancy data collection protocol, and one additional subject dropped out of the study. Subjects were recruited by phone and in person from the Cognitive Rehabilitation Research Group (CRRG), local outpatient stroke rehabilitation clinics, and the community. Inclusion criteria for participation in the study were: 1) clinical diagnosis of ischemic or hemorrhagic stroke, meeting ICD-9 criteria; 2) time since stroke ≥ 6 months; 3) sufficient cognitive ability to participate, as indicated by scores of 0–1 on the Questions and Commands items of the National Institutes of Health Stroke Scale (NIHSS); and 4) unilateral upper extremity paresis, as indicated by a score of 1 – 3 on the NIHSS Arm item. Exclusion criteria for participation in the study were: 1) severe hemi-neglect, as indicated by a score of ≥ 2 on the NIHSS Extinction and Inattention item; 2) inability to follow 2-step commands; 3) history or current diagnoses of any other neurological or psychiatric conditions; 4) concurrent participation in other upper extremity stroke treatments (e.g. outpatient therapy or Botox); or 5) if the subject would be unavailable for assessment or treatment sessions. This study was approved by the Washington University Human Research Protection Office and all subjects provided informed consent prior to participation.

Measures

Expectancy for achieving repetitions session-by-session

Numbers of Repetitions: We recorded both the target number of repetitions and the number of repetitions achieved by each individual at each session. The target number was set by the treating therapist at the beginning of each session according to previously defined rules (see Birkenmeier et al., for details). We calculated the difference between the target number of repetitions and the number of repetitions achieved as an index of how well subjects achieved their repetition goal for each session.

Expectancy-numeric rating scale (E-nrs): We used a standard 11-point numeric rating scale, where anchors reflected subject expectancy for achieving the target number of repetitions (see Appendix). A numeric rating scale is easy to use, quickly delivered, and easily understood by people (Williamson & Hoggart, 2005). A numeric rating scale is reliable and valid for measuring pain and has been found to be as sensitive as the visual analogue scale (Williamson & Hoggart, 2005). We chose to use a numeric rating scale because we felt it was the quickest and easiest way for subjects to repeatedly rate their expectations for repetition achievement. The E-nrs was administered by stating: “at the last session your target was ____ repetitions and you achieved ____ repetitions. Today your target is ____ repetitions. Please rate your expectations for reaching this number of repetitions using this 0 – 10 scale.” At the start of each treatment session, subjects rated their expectancy for achieving the target number of reps using the E-nrs; this resulted in a total of 18 expectancy ratings per subject.

Expectancy for upper extremity motor improvement

Credibility/Expectancy Questionnaire (CEQ) (Borkovec & Nau, 1972; G.J. Devilly & Borkovec, 2000): The CEQ assesses subject credibility, defined as “how believable, convincing, and logical the treatment is” and expectancy, defined as “improvements the client believes will be achieved.” The questionnaire consists of 6 questions, 3 that reflect credibility and 3 that reflect expectancy, which the subject answers with a rating of 0–10, or 0%–100% (see Appendix for expectancy questions). The CEQ takes approximately 10 minutes to administer. The average score for each construct determines separate credibility and expectancy scores. The CEQ has high internal consistency within each factor, and good test-retest reliability (G.J. Devilly & Borkovec, 2000). It is the most frequently used credibility and expectancy measure in psychosocial therapy research today (G.J. Devilly & Borkovec, 2000). Subject expectancy for the intervention as a whole was assessed one time per subject with the CEQ at a baseline visit. This was purposely measured after the intervention rationale was explained but before beginning the first intervention session. For this study, we used only the subject’s expectancy score in our data analysis.

Action Research Arm Test (ARAT): The ARAT is a criterion-referenced assessment of upper extremity motor ability (Lyle, 1981). The ARAT includes 19 items divided into four subscales measuring grasp, grip, pinch, and gross movement. On each item, the subject scores between 0 points, he/she cannot perform the task, and 3 points, he/she can perform the task normally within 5 seconds. Scoring was done according to recently published criteria (Yozbatiran, Der-Yeghiaian, & Cramer, 2008). A total score of 57 points indicates normal upper extremity motor ability. The ARAT was chosen as the primary measure to assess treatment outcome because 1) it has a low testing burden; 2) it has consistently strong psychometric properties in people with stroke (Beebe & Lang, 2008, 2009; Carey & Matyas, 2005; Cook, et al.; De Weerd & Harrison, 1985; Hsieh, Hsueh, Chiang, & Lin, 1998; Lyle, 1981; van der Lee, Beckerman, Lankhorst, & Bouter, 2001) and 3) it is widely used in upper extremity rehabilitation trials around the world (Dromerick, et al., 2009; Harris, Eng, Miller, & Dawson, 2009; Page, Sisto, Levine, & McGrath, 2004; Ross, Harvey, & Lannin, 2009;

Stinear, et al., 2007; van der Lee, et al., 1999). The ARAT was administered at all three baseline visits. At the end of the 6 week intervention, the ARAT was administered again. The three baseline ARAT scores were averaged, and the average value was subtracted from the post-intervention score to obtain the change in ARAT. The change in ARAT was used as the index of upper extremity motor improvement.

Statistical Analysis

Statistica version 6.1 software (StatSoft Inc, Tulsa OK) was used for all data analysis. Descriptive statistics were generated for each measure; all values in the Results are means $\pm$ standard deviations unless otherwise indicated. Non-parametric Spearman rank correlation coefficients were used to examine: 1) the relationships between treatment session expectancy (E-nrs) and target achievement (target repetitions - achieved repetitions) within subjects; and 2) the relationship between expectancy for the intervention as a whole (Expectancy portion of the CEQ), and upper extremity motor outcome (change in ARAT). Our small sample size limited the likelihood of obtaining statistically significant correlation coefficients. We therefore used the following criteria to interpret the magnitude of the coefficients. Coefficients of 0.25 or below were considered low, coefficients ranging from 0.26 – 0.50 were considered fair, coefficients ranging from 0.51 – 0.75 were considered good, and those greater than 0.75 were considered excellent (Portney & Watkins, 2000).

Results

Twelve subjects provided data on expectancy; subject characteristics are provided in Table 1. The average age of subjects was 54 years and 58% of the sample was female. The sample was variable with respect to age, time since stroke, and initial upper extremity motor function, as measured by the ARAT.

Expectancy for achieving repetitions session-by-session

Target numbers of repetitions ranged from 300 at the start of the intervention, to 400 repetitions by the end of the intervention. The average target number of repetitions was 320 ± 24 . The average number of repetitions achieved for the 12 subjects included in this report was 310 ± 57 . The difference between the target and the number of repetitions achieved at each session ranged from -191 to 214, where negative numbers indicate falling short of the target and positive numbers indicate exceeding the target. The average difference was -9 ± 36 . Ratings of expectancy for achieving the target number of repetitions ranged from 2 to 10, on the 0 to 10 point scale. The average rating across all subjects and sessions was 8 ± 1 .

Within-subject correlation coefficients between expectancy ratings and repetition achievement varied across individuals ($r = 0.00-0.84$; Table 2). Figure 1 shows example data from two subjects illustrating the higher and lower ends of this range. Data from one subject shows similar variations in expectancy scores and repetition achievement over the course of the 18 treatment sessions (subject R011, Figure 1A). Though both expectancy and repetition achievement varied, they varied together as indicated in the scatterplot in Figure 1B and by a high correlation coefficient ($r = 0.84$) between expectancy and repetition achievement. Data from the second subject show a consistently high expectancy rating despite inconsistent repetition achievement (subject R013, Figure 1C), and a low correlation coefficient ($r = 0.23$) between expectancy and repetition achievement (Figure 1D).

Expectancy for upper extremity motor improvement

Values of expectancy for improving upper extremity motor function ranged from 4 to 10 on the 0 to 10 point scale, with an average value of 7 ± 2 (Table 2). Change in ARAT scores for the 12 subjects included in this report ranged from 2 to 19 points with an average change of

7 ± 6 points (Table 2). The correlation between expectancy and change in ARAT was low ($r = 0.17$, $p=0.61$). Data are graphically displayed in figure 2.

Discussion

Outcome expectancy is an under explored area in the rehabilitation literature. This study adds to the emerging literature by exploring how expectations were related to two outcomes within and across treatment sessions for people with stroke. The correlations between expectancy and repetition achievement were inconsistent across subjects. Expectancy for improvement in upper extremity motor function was good, but had only a minimal correlation with improvement.

We found highly variable relationships between individual expectancy and repetition achievement per session across the sample. In some of our subjects, expectations and repetition achievements tracked together. A clinician working with these individuals may want to assess outcome expectations prior to beginning each therapy session and adjust his/her treatment plan based on the individual's expectations. Building the individual's outcome expectations through activity achievement and patient education could influence expectations and outcomes for subsequent therapy sessions. In other subjects however, there was almost no relationship between what they expected to achieve and what they did achieve. These subjects, it appears, may not benefit from treatment planning aimed at addressing or improving outcome expectations. Additionally, in those individuals with low correlations, we saw little evidence of adjusting subsequent expectancy ratings based on previous performance. Because it is a complex construct, expectancy is likely influenced by a number of factors, such as: age, education level, cognition, lesion location, affect, daily level of fatigue, and a desire to please the therapist (Collins & Hyer, 1986; G.J. Devilly & Borkovec, 2000; Resnick, 2001). It is plausible that other, unmeasured factors may account for the individual variability in relationships between expectancy and repetition achievement seen here. For example, executive function and awareness deficits are present in many people with stroke (Hartman-Maeir, Soroker, Oman, & Katz, 2003; Zinn, Bosworth, Hoenig, & Swartzwelder, 2007) and may make it difficult to make judgments (or learn from previous judgment "errors") about what one is capable of accomplishing.

People in this research intervention had generally good expectations for upper extremity motor improvement; they believed they would improve by participating in the intervention. In the one other study reporting expectancy ratings using the CEQ, the expectations of their subjects were similar to the expectations of ours (G.J. Devilly & Borkovec, 2000). We found only a minimal relationship however, between expectancy and upper extremity motor improvement. The correlation found here was at the low end of the range of values reported in the literature that relates expectancy to outcomes. In psychiatric studies, correlations between expectancy and outcome range from 0.20 to 0.68 (Collins & Hyer, 1986; G.J. Devilly & Borkovec, 2000; G. J. Devilly & Spence, 1999). Studies more closely related to rehabilitation reported correlations ranging from 0.30 to 0.45 (Resnick, 2001; Smeets, et al., 2008). Reports on the predictive ability of outcome expectations often involve hundreds to thousands of subjects (Collins & Hyer, 1986; Resnick, 2001; Smeets, et al., 2008), thereby making it more appropriate to generalize findings to the populations of interest.

Limitations

There are several limitations to consider when interpreting these data. First, the sample size was small, leaving us with the statistical power to identify only good or excellent relationships between variables. Future studies need substantially larger samples to confirm or refute these preliminary findings. Second, the E-nrs measure required subjects to mentally translate how much they thought they could achieve into a number between 0 and 10. This

translation could have been confusing to some of the subjects, although this did not appear to be the case when the measure was administered. It may be better in future investigations to simply ask people to estimate how many repetitions they expect to achieve during the session, instead of using the E-nrs. And third, our investigation was done using a convenience sample of volunteers participating in a research intervention. It remains to be determined how these findings generalize to the clinical experience of stroke rehabilitation.

Conclusions

These preliminary data show variable relationships between individual expectancy and repetition achievement and a minimal relationship between expectancy and upper extremity motor improvement. Methods employed in this exploratory study can be used for future studies in a clinical environment with large samples. Further work is needed to understand any relationships between expectancy and rehabilitation outcomes and the clinical implications of these relationships in people following stroke.

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Appendix

Expectancy-numeric rating scale

Please rate your expectations for reaching the targeted number of repetitions today.

0	1	2	3	4	5	6	7	8	9	10	
I definitely will not reach the target number of repetitions.											I definitely will reach the target number of repetitions.

Credibility Expectancy Questionnaire

- 1** By the end of the therapy intervention period, how much improvement in your stroke symptoms do you think will occur?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Close your eyes for a few moments, and try to identify what you really *feel* about the therapy intervention and its likely success. Then answer the following questions.

- 2** At this point, how much do you really *feel* that the therapy will help you to reduce your stroke symptoms?

0	1	2	3	4	5	6	7	8	9	10
Not at all			Somewhat				Very much			

- 3** By the end of the therapy period, how much improvement in your stroke symptoms do you really *feel* will occur?

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

(only questions which reflect expectancy score are displayed)

Figure 1.

Line graphs and corresponding scatterplots for two subjects. These plots illustrate the collected data and the range of relationships found between individual expectancy and repetitions achievement. A, C: Line graphs of the repetition expectancy scores across (right y-axis) sessions and the difference in repetitions across sessions (left y-axis). For the difference in repetitions, negative numbers indicate falling short of the target number and positive numbers indicate exceeding the target number. B: D: Scatterplots of subject repetition expectancy vs. difference in repetitions. A&B show data from subject R011; C&D show data from subject R013

Figure 2. Scatterplot of expectancy vs. improvement in upper extremity motor function, as indexed by the change in Action Research Arm test scores (ARAT). Each data point represents an individual subject. CEQ: Credibility and Expectancy Questionnaire.

Table 1

Subject characteristics

Subject	Age (yrs)	Gender	Time post stroke (mos)	Side affected	Dominant side affected	Baseline ARAT [†] score
R003	75	M	12	L	N	8
R005	44	F	6	R	Y	38
R006	44	F	36	R	Y	4
R007	55	F	120	L	Y	20
R008	28	F	48	R	Y	43
R009	57	M	18	L	N	9
R010	50	F	48	R	Y	40
R011	65	F	36	L	N	27
R012	56	M	57	R	Y	20
R013	57	F	36	L	N	15
R014	90	M	48	L	N	22
R015	33	M	22	R	Y	20
Mean/%	54.5	58%F	41	50% R	58% Y	22

[†] ARAT: Action Research Arm test, maximum (normal) score = 57; value is mean of the 3 baseline scores.

Table 2

Individual subject results for correlations between target repetitions achievement and expectations per session (research question 1), and expectancy rating for the intervention as a whole and improvement on the ARAT (research question 2).

Subject	Research Question 1	Research Question 2	
	Spearman rho (r)	CEQ* Expectancy Score	Improvement in ARAT [†] score
R003	0.11	7	3
R005	0.18	6	19
R006	0.42	4	2
R007	0.63	8	8
R008	0.73	9	13
R009	0.31	8	2
R010	0.04	10	13
R011	0.84	8	4
R012	0.55	5	4
R013	0.23	9	2
R014	0.38	6	9
R015	0.00	8	4

* CEQ: Credibility Expectancy Questionnaire, only the expectancy score is reflected above.

[†] ARAT: Action Research Arm test.