Exploring Expectations for Upper-Extremity Motor Treatment in People After Stroke: A Secondary Analysis

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OBJECTIVE. We explored expectations for outcomes during a research intervention for people with stroke.

METHOD. 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. We used Spearman rank-order correlation coefficients to evaluate the relationships.

RESULTS. Correlations between individual expectancy and session-by-session achievement ranged from 0 to .84. Expectancy for improvement from the intervention was good (average = 7 of 10) but had a low correlation (.17) with actual improvement.

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


Outcome expectancy is a person’s expectations for a successful rehabilitation outcome, assuming he or 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; Devilly & Borkovec, 2000; Devilly & Spence, 1999), people with low back pain (Smeets et al., 2008), and older adult patients in inpatient rehabilitation facilities (Resnick, 1998). Moreover, 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. In light of the heterogeneous populations cited, 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 industrialized world. Eighty percent of stroke survivors will experience hemiparesis early after stroke (Barker & Mullooly, 1997). Roughly 50% of survivors will need assistance with activities of daily living (ADLs) 6 mo poststroke (Legg et al., 2007). Recovery from stroke is a long process that takes 6–20 wk for a person to reach his or 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. Client expectations are an important feature of client-centered care. Systematically assessing each client’s expectations could foster better communication during the course of therapy services. In addition, clinicians working with patients after stroke
may want to consider individual 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, 2010). Although animal models of stroke involve 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, & Gnyp, 2007; Lang et al., 2009). In our study, people with stroke were encouraged to achieve ≥300 repetitions of task-specific upper-extremity training in 1-hr therapy sessions in an effort to improve the functional use of their affected upper extremity. We reasoned that this high number of repetitions might be feasible if the therapist and participant 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.

We explored the relationship between expectancy and two key outcomes of this intervention: (1) individual session-by-session repetition achievement and (2) improvement in upper-extremity motor function. First, we measured participants’ 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 client expectations and outcomes.

Method

This investigation into expectancy was part of a high-repetition dose study in which 12 participants attempted to complete ≥300 repetitions of task-specific upper-extremity training in 1-hr therapy sessions (Birkenmeier et al., 2010). This study was a within-subjects, repeated-measures cohort design. The study began with baseline visits, 1 per week for 3 wk, followed by the 6-wk intervention (3 sessions/wk = 18 total sessions). Postintervention assessments occurred at the end of the intervention and 1 mo later.

Intervention Specifics

Primary methods and results from the high-repetition intervention are detailed in another report (see Birkenmeier et al., 2010). Here, we briefly outline the intervention protocol. The high-repetition intervention consisted of supervised, whole-task, massed practice of functional daily tasks that were appropriately graded and progressed for each participant. An occupational or physical therapist or supervised occupational therapy student delivered the intervention in 1-hr treatment sessions. Participants were given the Canadian Occupational Performance Measure (Law et al., 1990) to assist in determining activities of interest and specific tasks to address during treatment sessions. An individualized approach to task selection (Higgins et al., 2006), not a general one (all participants do the same tasks), was selected because severity of paresis and personal interests vary across people with stroke. In addition, 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 participant. The job of the therapist was to grade tasks such that they challenged but did not overwhelm or underwhelm the motor capabilities of each participant. 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 participant; 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 on the basis of 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.
Participants

Twenty-seven participants were screened, and 15 were enrolled in the repetitions study. Twelve of the 15 participants provided expectancy data for this report. Two participants did not provide expectancy data because they were enrolled before the expectancy data collection protocol was finalized, and 1 additional participant dropped out of the study. Participants were recruited by phone and in person from the Cognitive Rehabilitation Research Group, local outpatient stroke rehabilitation clinics, and the community. Inclusion criteria for participation in the study were as follows: (1) clinical diagnosis of ischemic or hemorrhagic stroke, meeting International Classification of Diseases (9th ed.; World Health Organization, 1980) criteria; (2) time since stroke ≥6 mo; (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; Brott et al., 1989); and (4) unilateral upper-extremity paralysis, as indicated by a score of 1–3 on the NIHSS Arm item. Exclusion criteria for participation in the study were as follows: (1) severe hemineglect, as indicated by a score of ≥2 on the NIHSS Extinction and Inattention item; (2) inability to follow two-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 botulinum toxin); or (5) unavailable for assessment or treatment sessions. This study was approved by the Washington University Human Research Protection Office, and all participants provided informed consent.

Measures: Expectancy for Achieving Repetitions Session by Session

Number of Repetitions. We recorded both the target number of repetitions and the number of repetitions achieved by each participant 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., 2010, for details). We calculated the difference between the target number of repetitions and the number of repetitions achieved as an index of how well participants achieved their repetition goal for each session.

Expectancy–Numeric Rating Scale. We used a standard 11-point numeric rating scale on which anchors reflected participant expectancy for achieving the target number of repetitions (see Appendix, available online at www.ajot. ajotpress.net; navigate to this article, and click on “supplemental materials”). A numeric rating scale is easy to use, quickly delivered, and easily understood (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 analog scale (Williamson & Hoggart, 2005). We chose to use a numeric rating scale because we felt it was the quickest and easiest way for participants to repeatedly rate their expectations for repetition achievement. The Expectancy–Numeric Rating Scale (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, participants rated their expectancy for achieving the target number of reps using the E–nrs; this process resulted in a total of 18 expectancy ratings per participant.

Measures: Expectancy for Upper-Extremity Motor Improvement

Credibility/Expectancy Questionnaire. The Credibility/Expectancy Questionnaire (CEQ; Borkovec & Nau, 1972; Devilly & Borkovec, 2000) assesses participant 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 six questions, three that reflect credibility and three that reflect expectancy, which the participant answers with a rating of 0–10 or 0%–100% (see online Appendix for expectancy questions). The CEQ takes approximately 10 min 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 (Devilly & Borkovec, 2000). It is the most frequently used credibility and expectancy measure in psychosocial therapy research today (Devilly & Borkovec, 2000).

Participant expectancy for the intervention as a whole was assessed one time per participant with the CEQ at a baseline visit. It was purposely measured after the intervention rationale was explained but before beginning the first intervention session. For this study, we used only the participant’s expectancy score in our data analysis.

Action Research Arm Test. The Action Research Arm Test (ARAT; Lyle, 1981) is a criterion-referenced assessment of upper-extremity motor ability. It includes 19 items divided into four subscales measuring grasp, grip, pinch, and gross movement. On each item, the participant scores between 0 points (he or she cannot perform the task) and 3 points (he or she can perform the task normally within 5 s).
Scoring was based on 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 it has a low testing burden, it has consistently strong psychometric properties in people with stroke (Beebe & Lang, 2008, 2009; Carey & Matyas, 2005; Cook et al., 2010; De Weerdt & Harrison, 1985; Hsieh, Hsueh, Chiang, & Lin, 1998; Lyle, 1981; van der Lee, Beckerman, Lankhorst, & Bouten, 2001), and 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-wk intervention, the ARAT was administered again. The three baseline ARAT scores were averaged, and the average value was subtracted from the postintervention 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 (StatSoft Inc., Tulsa, OK) was used for all data analysis. Descriptive statistics were generated for each measure. Nonparametric Spearman rank correlation coefficients were used to examine the relationship between treatment session expectancy (E–nrs) and target achievement (target repetitions–achieved repetitions) within participants and 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 (Portney & Watkins, 2000):

- Coefficients of ≤.25 were considered low.
- Coefficients ranging from .26 to .50 were considered fair.
- Coefficients ranging from .51 to .75 were considered good.
- Coefficients >.75 were considered excellent.

Results

Twelve participants provided data on expectancy; participant characteristics are shown in Table 1. The average age of participants was 54 yr, and 58% of the sample were women. The sample was variable with respect to age, time since stroke, and initial upper-extremity motor function, as measured by the ARAT. All values described in this section are means ± standard deviations (SDs) unless otherwise indicated.

Expectancy for Achieving Repetitions Session by Session

Target numbers of repetitions ranged from 300 at the start of the intervention to 400 by the end of the intervention. The average target number of repetitions was 320 ± 24. The average number of repetitions achieved for the 12 participants 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 participants and sessions was 8 ± 1.

Within-subject correlation coefficients between expectancy ratings and repetition achievement varied across participants (rs = .00–.84; Table 2). Figure 1 shows example data from 2 participants illustrating the higher and lower ends of this range. Data from 1 participant show similar variations in expectancy scores and repetition achievement over the course of the 18 treatment sessions (Participant R011, Figure 1A). Although both expectancy and repetition achievement varied, they varied together as indicated in the scatterplot in Figure 1B and by a high correlation coefficient (r = .84) between expectancy and repetition achievement. Data from the second participant show a consistently high expectancy rating despite inconsistent repetition achievement (Participant R013, Figure 1C), and a low correlation coefficient (r = .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 and had an average value of 7 ± 2 (Table 2). Change in ARAT scores for the 12 participants 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 = .17, p = .61). Data are graphically displayed in Figure 2.

Discussion

Outcome expectancy is an underexplored 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 participants. 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. For some of our participants, expectations and repetition achievements tracked together. A clinician working with such patients may want to assess outcome expectations before beginning each therapy session and adjust his or her treatment plan on the basis of the patient’s expectations. Building the person’s outcome expectations through activity achievement and patient education could influence expectations and outcomes for subsequent therapy sessions. In other participants, however, almost no relationship was found between what they expected to achieve and what they did achieve. This group, it appears, may not benefit from treatment planning aimed at addressing or improving outcome expectations. In addition, for participants with low correlations, we saw little evidence of adjusting subsequent expectancy ratings on the basis of previous performance.

Because it is a complex construct, expectancy is likely influenced by many factors, such as age, education level, cognition, lesion location, affect, daily level of fatigue, and

### Table 1. Participant Characteristics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Age, yr</th>
<th>Gender</th>
<th>Time Poststroke, mo</th>
<th>Side Affected</th>
<th>Dominant Side Affected</th>
<th>Baseline ARAT Score</th>
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<td>R003</td>
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<td>R012</td>
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<td>Mean or %</td>
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<td>58%</td>
<td>41</td>
<td>50% Right</td>
<td>58% Yes</td>
<td>22</td>
</tr>
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</table>

*Note.* Maximum (normal) score = 57; value is mean of the three baseline scores. ARAT = Action Research Arm Test.

Figure 1. Line graphs and corresponding scatterplots for 2 participants. For Participant R011, \( r = .84 \) (Panel B); for Participant R013, \( r = 0.23 \) (Panel D).
a desire to please the therapist (Collins & Hyer, 1986; 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 one other study reporting expectancy ratings using the CEQ, the expectations of participants were similar to those of our participants (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 ranged from .20 to .68 (Collins & Hyer, 1986; Devilly & Borkovec, 2000; Devilly & Spence, 1999). Studies more closely related to rehabilitation reported correlations ranging from .30 to .45 (Resnick, 2001; Smeets et al., 2008). Reports on the predictive ability of outcome expectations often involve hundreds to thousands of participants (Collins & Hyer, 1986; Resnick, 2001; Smeets et al., 2008), thereby making it more appropriate to generalize findings to the populations of interest.

Limitations

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. Also, the E–nrs measure required participants 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 participants, although that 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. Finally, 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 used 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 after stroke.
Acknowledgments

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References


