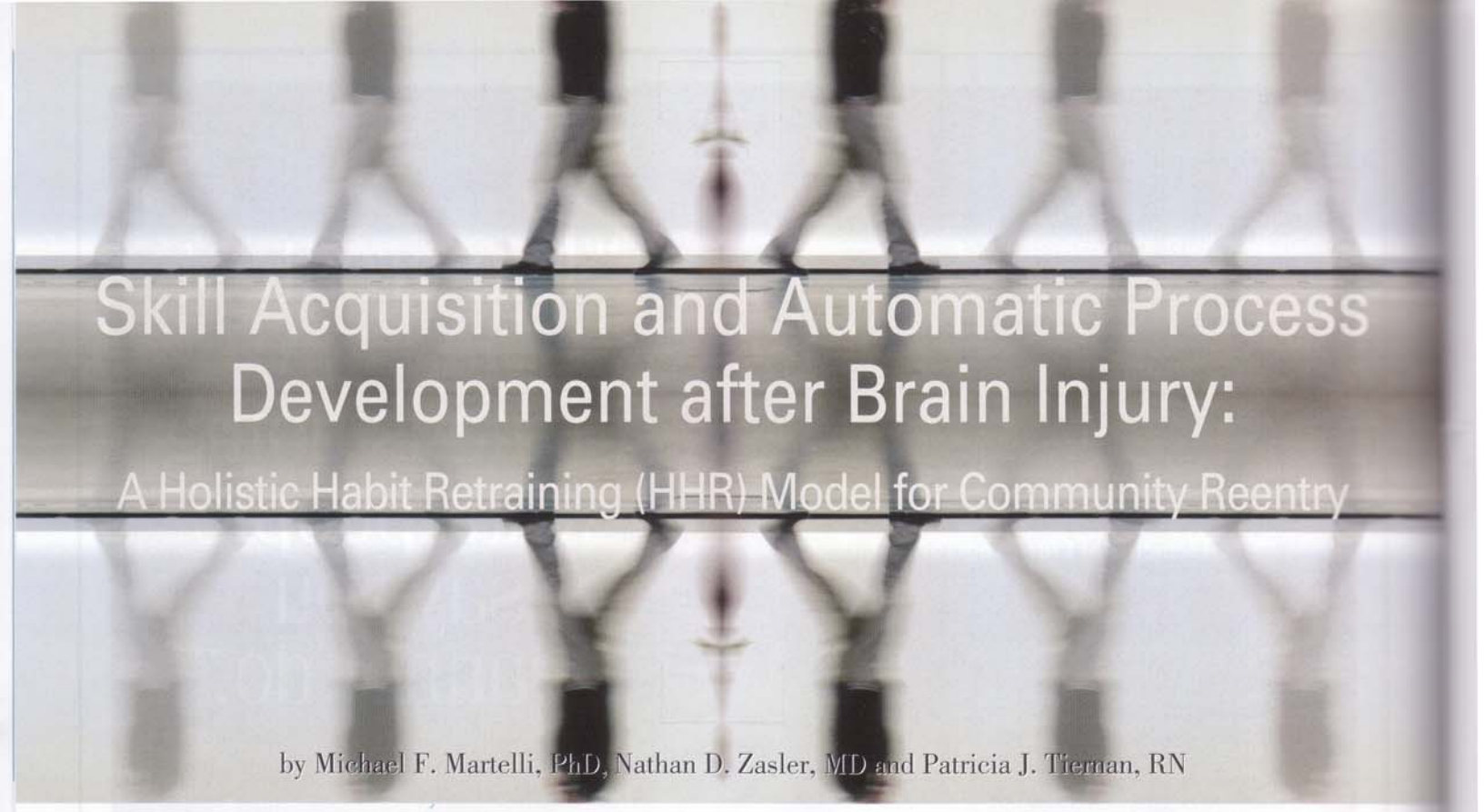

Skill Acquisition and Automatic Process Development after Brain Injury:

A Holistic Habit Retraining (HHR) Model for Community Reentry

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I. INTRODUCTION

Persistent cognitive, emotional and behavioral dysfunction following brain injury present formidable challenges in the area of brain injury rehabilitation. This article reviews a model of community based neurorehabilitation, along with illustrative methodology, that conceptualizes brain injury sequelae in terms of disruption of previously established habits that are hierarchical, interdependent and underlie all efficient, adaptive living skills. In this paper, a Holistic Habit Retraining (HHR) model and methodology of neurorehabilitation (Martelli, 2003; 2003) is eluciated which issues from:

The "automatic learning" and "errorless learning" literature and recent supportive evidence of skills relearning after brain injury;

A task analytic examination of acquisition of relevant habits as a model for building skills retraining protocols;

Analysis of organic, reactive, developmental, and characterologic obstacles to, and facilitators of, strategy utilization; and

A strategy for promoting rehabilitative strategy use adapted to acute neurologic losses, an individual's inherent reinforcement preferences and coping style, and reliant on naturalistic reinforcers which highlight relationships to functional goals, utilize social networks, and employ a simple and appealing cognitive attitudinal system and set of procedures.

Holistic Habit Retraining (HHR: Martelli, 1999; 2002; 2003) offers a model and methodology for continuing community based neurorehabilitation that integrates psychotherapeutic strategies as necessary rehabilitation process ingredients. As such, HHR reduces the complexity of both doing psychotherapy with persons with acquired neurologic disorders and identifying and facilitating accomplishment of meaningful individual goals through optimal learning procedures. HHR does this by simplifying and integrating the processes and methods of interdependent goal accomplishment in psychotherapy & rehabilitation. The HHR Model of Rehabilitation presents practical, utilitarian strategies for retraining adaptive cognitive, emotional, behavioral and social skills, as well as strategies for overcoming common obstacles to utilizing methods that promote effective habit acquisition.

II. Rehabilitation and the Holistic Habit Retraining (HHR) Model: Rehabilitation is Relearning.

The understanding of brain function may not be complete, but we do know that the ability to learn and store information and execute tasks related to that learning is dependent on intact brain cells. Damage to brain cells that occurs in acquired brain injury (ABI) can diminish or delete the stored knowledge and habits that sustain important human abilities.

Fortunately, even though damage to brain cells can erase the stored knowledge and habits associated with them, the ability to re-learn is seldom destroyed. Importantly, human beings are equipped with a highly evolved brain that makes them the greatest learning organisms ever to roam the earth. While animals are controlled by instincts, human behavior is driven by complex learning and the establishing of a network of complex habits. From the time of birth, human behavior is predominantly shaped by learning. Everyday functioning becomes increasingly sophisticated through the construction of a complex sequence of hierarchically arranged habits with more complex habits built on top of more basic habits. The complex behaviors that make up the average persons everyday behaviors are performed efficiently and automatically because of the establishment of a hierarchy of habits acquired through incremental learning. The important role of habits was recognized by William James, the father of American Psychology, who referred to them as the flywheel of society (James, 1890).

The capacity of the human brain to convert repeatedly performed behaviors into habits is the mechanism of neural plasticity which allows the learning of complex behaviors that can be performed automatically. This ability of the human brain to manufacture habits and produce its own learned instincts enables man to perform tasks automatically while concentration, energy and effort are freed up for other tasks. At the same time, damage to neural tissue can weaken or erase some of the most basic acquired habits of adaptive living. Everyday abilities and routines can be seriously disrupted while efficiency is lost. What was once automatic can require an enormous amount of effort, as if the tasks were being performed for the first time, before efficient ways of performing the components of daily activities were learned. Fortunately, even if very basic and important learned habits are erased, newly learned habits can be developed as replacements.

Importantly, we know the primary requirements for both learning and relearning. Our emotional state, our attitudes and our expectancies constitute some of the most important variables relating to how much can be relearned, and how well habits can be replaced (e.g., Wood, 2004; Martelli, in preparation). Emotions and attitudes can either promote and guide re-establishment of new habits, or prevent their development. If we think or expect that we cannot learn, if we think only the old learning/ way of knowing how to do things are sufficient, or if we think that only children can or should learn, we will undermine relearning. Such attitudes contaminate relearning and are poisonous to rehabilitation.

In the HHR model, the essential ingredients for relearning and reha-

bilitation can be roughly summarized in three basic components, the 3 P's, or the Plan, Practice and Promoting attitude:

The **Plan** component is a prescriptive strategy or design for stepwise progress toward relearning a desired task or behavioral sequence. Plans are derived from thorough functional task analyses. Functional task analyses are the most relied upon building block of relearning and involve breaking seemingly complex tasks down into simple component steps, and demarking them on a checklist that can be followed in a list wise fashion. Clearly, the more specific, concrete, and conspicuous the prescription for successful task completion, the more likely the plan can be effectively utilized.

The **Practice**, or repetition component, involves repeated and consistent trials of practice, conducted over many weeks to months. It is the cement for learning that makes complex, challenging and cumbersome or boring tasks more automatic and effortless. This is the habit manufacturing process stage. With practice and repetition, even complex tasks become automatic and habitual. That is, a habit, or our automatic robots, can perform many tasks for us without special effort, energy, concentration, memory, or other cognitive demands.

The **Promoting attitude** (or facilitative attitude) component fuels the prerequisite mobilization and persistence of energy for sustaining the repeated practice necessary for establishing reliable skills learning. Sustaining motivated practice over numerous repetitions, sometimes very many, and over a progressive series of challenging sequences, is required to achieve automaticity in performance of adaptive task sequences and behavioral habits. The promotional attitude facilitates and shapes continued practice, incremental (baby step) expectancies and self-reinforcement for incremental gains. It fosters resistance to such adaptive attitude challenges as significant anger, frustration, depression, fear, pessimism, feelings of victimization, self pity and, importantly, the kind of low grade chronic despair that is frequently left over from the early post-injury experience of being confronted by overwhelming deficits.

Perhaps the greatest obstacle to learning or relearning is the redirection of energy away from sustained goal directed activity and toward debilitating activity. Some of the most potent relearning or rehabilitation debilitating attitudes, or poisons, are depression, anger and resentment, feelings of victimization, fear, and inertia. These are the obstacles that not only redirect energy away from relearning, but inhibit it. They reflect the catastrophic emotional reactions following brain injuries that represent significant internal obstacles that must be removed as barriers before the very challenging process of relearning can be optimally achieved (Miller, 1998, 2000; Martelli, 2003).

III. The Catastrophic Reaction

Central postulations in the HHR model are that significant emotional reactions typically follow neurologic injuries, that these reactions often exert persistent negative influence, and that they require treatment to optimize rehabilitation. Early after injury, the discovery of traumatic loss of abilities and accustomed aspects of the self can be overwhelmingly devastating to the affected individual. The sudden loss of function in a limb, the inability to stand or the inability to control one's bowels or express a need through speech or understand another persons words can produce a powerful reaction characterized by incredible despair and distress. This response has been observed after left hemisphere stroke, other strokes, brain injury and other neurologic insults and was labeled the "catastrophic reaction" by Kurt Goldstein (1939, 1995). The acute despair that is initially experienced usually becomes less acutely manifested over time, although much of it can remain just below the surface. For example, it can be expressed in significantly reduced frustration tolerance (Prigatano, 1987) and aggravated by fatigue and metabolic changes (Sbordone, 1990).

The catastrophic reaction described by Goldstein was best captured in the extreme catastrophic emotion he observed in patients after left- hemisphere lesions. When faced with unsolvable tasks, states of ordered behavior decompensate into catastrophic reactions showing all the characteristics of acute anxiety. He viewed this as the person struggling to cope with the challenges of the environment and his/her own changed body. Goldstein argued that the person could not be divided into "organs" or "mind" & "body", and defined disease as a changed state of adaptation with the environment versus tissue damage. This early biopsychosocial conceptualization posited that "healing" came from adaptation to conditions causing the new state of person-environment interaction, and not through "repair".

As previously noted, passage of time is accompanied by decreased acuity of the catstrophic reaction. Although "adaptation" may explain decreased salience of catastrophic reactions, observations of patients over long periods of time suggests that less visible catastrophic emotional reactions can continue to operate on persons long after injury and even interminably. The catastrophic reaction can be frequently maintained or recapitulated through the continued confrontation of injury related deficits and requirement for chronic compensatory efforts (e.g., Hopewell, 2001; Prigatano, 1997; Prigatano, 1999; Martelli, 2003).

Clearly, continued confrontation of residual deficits and the chronic compensatory efforts that follow injuries, even though less overtly expressed, can create the kind of anxiety, frustration and resignation that converts progress inspiring hope and energetic efforts to feelings of powerlessness, helplessness and being overwhelmed by the challenge of coping. In the HHR model, the remnants of early catastrophic reactions are seen as frequently underlying the negative, energy consuming emotions that deplete the precious energy, hope and persistent goal directed effort necessary for successful goal achievements.

The most critical tenet of the habit retraining model is the postulation that persistent catastrophic emotional reaction is a frequent but often subtle impediment to adaptation that must be resolved in order to optimize rehabilitation. Further, considerable observational data and as yet unpublished case reports collected by the authors, along with emerging research reports in related areas (e.g., Taub, Uswatte & Morris, 2003; Taub, Crago & Uswatte, 1998; Sbordone, 1990) indicate that the gains that can follow resolution of the catastrophic reaction, when combined with the most facilitative retraining, can be impressive improvements in functional status and adaptation even many years after injury.

The conceptualization of many mental health and rehabilitation syndromes as reflecting problems in adaptation and coping with injury is certainly not new. Miller (1998; 2000) has nicely summarized the empirical and theoretical work in the area of post traumatic accidents that produce long-term demoralizing disability and conceptualized the group of traumatic disability syndromes as "neurosensitization syndromes". Disorders such as persistent postconcussion syndrome, chronic pain, posttraumatic stress disorder, depression, and others, share common pathophysiological mechanismas and are hypothesized to develop as the result of progressively enhanced sensitivity or reactivity of central nervous system (CNS) mechanisms causing persistent CNS changes. These syndromes are frequently comorbid and can create vicious cycles of impairment and reduced quality of life. A primary mechanism in the perpetuation of disability in these disorders is an avoidance of stimuli that evoke anxiety and emotional distress.

The idea that persistent emotional distress must be reduced in order to improve functional adaptation in many mental health and rehabilitation disorders is also not a new idea. For example, Miller (1998; 2000) notes that the same classes of psychotropic medications are usually the first stop gap measures for most of these disorders, while psychotherapy is usually the treatment of choice. Dubovsky (1997) describes that the psychotherapy relationship "splints" neurophysiological regulatory mechanisms and provides a repeated corrective stabilization that eventually allows normal functioning. Ben Yishay (2000) has devised a system of holistic neuropsychotherapy which is the central part of his rehabilitation program and Prigatano (1987, 1999) has strongly articulated the importance of psychotherapy for facilitating post injury adaptation. In the HHR model, resolving the persistent catastrophic reaction is seen as a prerequisite to rehabilitation and is integrated into the rehabilitation training process.

The HHR rationale and method for resolving the persistent catastrophic reaction comes largely from the research literature on learning (e.g., Schachter, 1996), cognitive-behavioral psychotherapy, and coping with anxiety, especially procedures involving graduated exposure and cognitive restructuring (Masters, Burish, Hollon & Rimm, 1987). In HHR methodology, resolving the persistent catastrophic reaction involves three integrated components:

1) Confronting deficits in an incremental manner in order to prevent being overwhelmed by distressful emotion, through graduated exposure.
2) A supportive conceptual framework and rehabilitation methodology that bolsters hope and includes self-instruction to reinforce graduated successes in very incremental goal achievement toward desired goals.
3) A rehabilitation methodology that emphasizes errorless learning and task analyses, as described below, in order to simplify reacquisition and habitualization of many basic adaptational skills while minimizing anxiety and distressful emotions associated with failure.

The HHR methodology is designed to promote learning through calming the central nervous system and decreasing the significant anxiety and negative emotional states which are consistently shown to be disruptive to performance and learning (e.g. Ormod, 1999). It specifically focuses on decreasing the catastrophic emotional, cognitive and neurophysiologic reactions that would block optimal relearning. At the same time, it is designed to counter residual

learned avoidance responses that may have been conditioned in the remote past when catastrophic reactions were more potent and conspicuous

The summary of many years of attempts to identify adaptive, rehabilitation promoting attitudes characterized by rehabilitation patients who were able to achieve remarkable progress despite seemingly insurmountable odds, is included in the "Five Commandments of Rehabilitation". These commandments serve as a primary prescription for countering the catastrophic emotional reactions that block optimal rehabilitation achievement. They are integrated in a model that prescribes that the optimal confrontation of deficits must occur: (a) incrementally, to reduce being overwhelmed by their magnitude; (b) with a methodology that promotes graduated successes through incremental expectancies, accurate self monitoring and incremental self reinforcement and is necessarily integrated with a supportive conceptual framework that reduces debilitative emotional reactions and allows adaptive reinterpretations of experience to promote hopefulness, self efficacy and self-esteem.

Importantly, the envisioning of a progressively more desirable future is the guiding principle and psychoemotional magnet in HHR that pulls persons toward their goals. Incremental movement toward desired goals can be achieved to the extent that a person focuses on the vision of a desirable future, breaks expectancies and goals into small, progressive steps, and develops rehabilitation habits that facilitate persistent and stepwise, goal directed efforts. Patterns of interpreting events and expectancies about how things will turn out represent predictions of the future. Habitual patterns of expecting failure or dissatisfaction, or mistreatment, and habitual patterns of becoming depressed, angry, fearful and/or resigned are energy depleting debilitative habits that reinforce disability and failure.

In contrast, the single best remedy, or antidote, is a habit that reinforces self-esteem through graduated successes. This facilitative habit is summarized in the "Five Commandments of Rehabilitation" (Martelli, 1999). Making accurate comparisons, learning new ways to do old things, building one self up and employing positive self-coaching, and viewing rehabilitation as a series of small steps each requiring celebration, are some of the important attitudinal prescriptions offered by "the commandments"(see Table 1).

The antidotes included in the "Five Commandments of Rehabilitation" are the medicines that interrupt the rehabilitation poison cycles. Importantly, energy tends to be self propagating in a cyclical fashion. If it proceeds in a negative direction, in catastrophic negative interpretations and expectations, more and more energy will be expended nonproductively. This direction of energy depletes it and redirects it away from allocation toward adaptive relearning and rehabilitation accomplishments. For example, a habitual depressive response to physical losses can reduce activity, prevent adaptive relearning, and reinforce more depression by depletion of brain chemicals associated with positive mood and energy. More depression, in turn, leads to poorer progress and more reason to be depressed.

Antidotes like the "Five Commandments", a positive vision of a gradually improved future, and planning and practicing compensatory behavioral self-control strategies serve to protect the rehabilitation reserve by inoculating persons against depression, anger, and destructive emotion. This ensures that energy and motivation will be available for the persistent pursuit of desired goals, with each step of progress adding new hope, self-efficacy, energy, and effort for the next step. With the addition of task analyses and scheduling to help promote routines, energy is increasingly turned toward protecting the rehabilitation energy reserve through adaptive interpretations and expectancies. Consistent repeated practice turns these rehabilitation promoting strategies into increasingly automatic habits that allow achievements that further strengthen them.

To reiterate, anything that is consistently repeated will become a habit. Therefore, the HHR model promotes the attitude and activity routines that will produce facilitative habits that turn energy toward protecting attitudes, taking antidotes, and letting healing reserve help nudge patients toward their goals.

IV. Neuroplasticity, Rehabilitation and Relevance of the Catastrophic Reaction

In an editorial in the British Medical Journal, Richard Greenwood (2001) summarized the recent explosion of research into the three "R"s of restorative neurology: how Retraining reorganizes neural circuits and networks; the Replacement of cells and chemical messengers; and Regrowth of axons, dendrites, and synaptic connections. From both animal and human research, it is now known that remodelling of the cortex and other parts of the brain and spinal cord after brain lesions is not only possible, but use-dependent and task-specific. This remodelling explains why functionally useful rehabilitation and retraining techniques can work. It is the basis for his call for hastening the incorporation of such treatments as constraint induced movement therapy into clinical practice, for increased research efforts exploring treatment induced plasticity in the nervous system and for guiding the training of neurologists and other practitioners.

Some of the most powerful evidence relating neural plasticity and rehabilitation efficacy comes from recent research on constraint induced movement therapy (CIMT). CIMT grew out of animal research that has been expanded to humans (Taub, 1977; Taub, Crago & Uswatte, 1998; Kunkel, Kopp, Müller, Villringer et al, 1999; Taub, Uswatte, Morris, 2003). CIMT techniques induce patients with stroke, brain injury and other types of injury to practice using an affected limb on an intensive, concentrated or massed practice basis for consecutive weeks, usually >= 6 hours/day for approximately 2 weeks) while constraining use of the less-impaired arm (for 24 hours/day). Demonstration in controlled studies show substantial functional improvements in the actual amount of use of the more-impaired arm in activities of daily living coincident with a large use-dependent cortical reorganization that substantially increases the size of the cortical motor control areas for the affected limb. Continuing research indicates that the concentrated intensity of retraining efforts is the most critical component in CIMT.

Further, the demonstration of improvements in humans many years after injury, along with creative research on monkeys, indicates that a significant portion of disability is explained by "learned non-use". Taub (Taub, Crago & Uswatte, 1998) notes that in the early period post injury, initial inability to use a body part produces failure and punishment for use attempts versus rewards for using other body parts. Subsequently, after resolution of original acute organic damage and return of potential for retraining and regrowth for body part use, the powerful learned inhibition of movement persists, and usually permanently. CIMT has demonstrated that this learning can be reversed.

Taub's research has described that an organism learns to discontinue use attempts early post injury because of incoordination, pain and the punishing effects of repeated failures. Similar to Seligman's *learned helplessness* model of depression and coping (Seligman & Isaacowitz, 2000), this demonstrates that learning and expectancy are extremely powerful determinants of behavior and health. Moreover, this demonstration provides strong evidence that the "catastrophic reaction" to impairments is a residual effect of injury and that emotional reactions and learning strongly influence the course of disability. Importantly, the CIMT research provides empirical support for Goldstein's observations and biopsychosocial model indicating that neurologic disability following an injury is more of an adaptational phenomenon than a

TABLE 1

Five Commandments of Rehabilitation

Commandment 1: Thou Shall Make Only Accurate Comparisons. Thou shall not make false comparisons.

That is, it is only fair (and adaptive) to compare oneself to persons with similar injuries, illnesses, disabilities and stress. It is unfair to compare ourselves to others without similar challenges, or to ourselves before we were challenged, as this makes us look poor by comparison. It is fair, however, to compare ourselves to others of similar injury, challenge, age, etc., as this comparison allows us to accurately measure ourselves.

Commandment 2: Thou Shall Learn New Ways to Do Old Things.

Learning new ways, or finding another way to do desired tasks, vs. giving up & feeling hopeless because the old way doesn't work, is the key to Challenging obstacles and overcoming them.
...Overcome Thinking that the old way is the best way (i.e., Stinking Thinking)

Commandment 3: Thou Shall Not Beat Thyself Up...Instead, Thou Shall Build Thyself Up!

We clearly understand that when we have a physical injury, such as a broken leg, getting mad, yelling at, or hitting (i.e., beating up) the leg only delays recovery, increases symptoms and pain, and makes us and the leg function worse. We know that pampering the leg, massaging it and coaxing it along gently & patiently will help it recover. Unfortunately, we too often forget that our brains are similar. An injured brain will perform poorly when we get mad with it, or get frustrated. Instead, understanding it, pampering it, being patient, using pacing & coaxing it along in a supportive way will help us function our best, and help our recovery and rehabilitation. Talking to ourselves in supportive and understanding ways (vs. getting mad at ourselves for being injured) and coaxing things out gently is a good way of building ourselves up in order to face the challenges of rehabilitation. Rewarding ourselves for efforts and each small step of progress, despite tremendous obstacles & challenges, is the best way to build ourselves up!
...Child & Spouse Abuse are recognized as illegal and immoral....Self Abuse is just as bad!

Commandment 4: Thou Shall View Progress as a Series of Small Steps.

Rehabilitation is appropriately viewed One Step At a Time - by focusing on the gains over where we were when we were one step behind where we are now, we can focus on the Graduated Successes and feelings of accomplishment (despite giant obstacles) which will leave us feeling proud and hopeful and enable us to focus and reach the next small step ahead, and make progress through the many small steps necessary to make substantial progress. Focusing on our current gains and small steps of progress (compared to where we were earlier in rehab and when we were at our worst) will build hope and a sense of challenge and growing victories (versus comparing ourselves to before the injury, which only makes us feel sad & depressed.
Inch by Inch & It's a Cinch. Meter by Meter, Life is Sweeter.

Commandment 5: Thou Shall Expect Challenge & Strive to Beat It.

By Converting Complaint (I don't want) To Challenge (I want), We Can Shape Our Future Through Our Vision and Driving Thoughts. We will actively shape our future by focusing on a vision of hope, challenge, control & satisfaction. By changing our focus from complaint and feelings of victimization & helplessness & pessimism, we can avoid giving up and giving in to a pessimistic prophecy of dissatisfaction and doom. (cf. "Thou Shall not Pretend to Have a Contract Guaranteeing Freedom from Injury, Disease, Illness or Unfair circumstances or Significant Stress!")

simple reflection of diseased brain tissue. The adaptional nature of disability is also supported by a very recent research report that investigated and offered direct empirical support for anxiety-related avoidance of activities after brain injury (Riley, Brennan & Powell, 2004). Most important for the HHR model, CIMT and other emerging research provides strong and accumulating evidence that catastrophic reactive emotional distress following injury can suppress rehabilitation, and that this suppression can be reversed.

V. Errorless Learning

There are a growing number of studies that consistently demonstrate effectiveness of errorless training methods for teaching skills to impaired individuals who were previously unresponsive to trial and error teaching. Evidence for errorless strategies was initially presented for persons with severe learning disabilities and dementia, but has recently emerged in the treatment of persons with aphasia, Parkinson's disease, schizophrenia, autism, and many other neurologic and neuropsychiatric disorders. This includes an increasing number of studies demonstrating efficacy and relative superiority over traditional trial and error methods in treatment of persons with significant memory problems following brain injury (Glisky and Schacter, 1989; Verfaellie, Cermak, Blackford and Weiss, 1990; Leng, Copello and Sayegh, 1991; Schachter, 1996; Squires, Hunkin and Parkin, 1997 Clare, Wilson, Carter, Roth and Hodges, 2002; Kern, Liberman, Kopelowicz, Mintz & Green, 2002; Ducharme, 2003; Kessels and dee Haane H, 2003; Masters, MacMahon and Paul, 2004; Schmitter-Edgecombe and Beglinger, 2001).

Errorless learning strategies are straightforward and relatively simple. They involve preventing persons from making either most or all errors during learning trials. Necessary assistance and support is offered to ensure successful task completion. Assistive cues can take the form of task analytically derived checklists (see below) or through verbal instruction. For example, in the "method of vanishing cues", maximum cues are provided and progressively withdrawn only as not needed for successful task performance. The reduction in the number of competing memory traces and elimination of frustration and distressful emotional responses is associated with improvement in memory and learning performance.

In contrast, traditional learning methods include trial and error procedures and involve effortful supposition and guessing. Although errorful methods can be very effective for unimpaired learners, they can tax and overwhelm persons with compromised attentional, memory and/or executive skills. In persons with these deficits, failure recollections interfere with recall of successful efforts in a limited memory store, while learning can be further undermined by requirement for recalling and discriminating component task steps for memories of successes versus failures. Further, failures typically produce frustration and distress that is especially inhibitory to learning in persons with brain injuries, given frequent reductions in attentional capacity and frustration tolerance and vulnerability to rekindling patterns of catastrophic reactions to deficits. In errorless learning, only correct and successful

TABLE 2 Task Analysis Samples

TA Samples: Single Tasks

'Making A Bed'	1. Strip sheets, blankets and pillow cases 2. Put blankets and pillows on table 3. Take break 4. Get sheets and pillow cases from closet	*At This time, doing with Mom:* 5. Put on fitted sheet 6. Put on top sheet, evening it out 7. Put on blankets and tuck in corners 8. Put pillow cases on pillow 9. Put comforter on bed
Vacuum Cleaning Task Analysis	1. Remove Cleaner and Parts From the Closet	canister handle floor brush hand brush crevice
	2. Unwind Power cord	
	3. Decide task	carpets wood/vinyl floors hand dusting change dust bag
	4. For Carpets	attach power handle adjust carpet level on canister turn on power vacuum first in main traffic paths and then to the sides turn off power
	5. For Hard Floors	attach long handle brush turn on power vacuum from the center outward turn off power removee handle clean brush head with vacuum power
	6. For Hand Dusting	attach brush head to hand grip turn on power carefully dust all surfaces turn off power remove brush and clean it with vacuum handle
	7. Change Dust Bag	when red light on canister comes on, or check monthly when bag supply is low, purchase more at Sears. Bring code# to store. open canister, carefully pull bag off attachment. place dirty bag carefully into the trash put new bag following reverse procedure
	8. After Cleaning	recoil power cord into canister store all parts in the closet

TA Sample: Daily Habits & Routines

AT's Initiative/Energy Retrainer	MORNING	Wash Face Shave Apply medication to face if needed Brush Teeth Comb Hair Dress before "morning" nap Check finger nails & toe nails; trim when needed Check hair length and get a haircut as needed Shower and wash hair Perform an Activity/Chore (Choose from Menu) Check Schedule (e.g., M,W,F=Y; Tues=RedX) Check your appearance before leaving the house	AFTERNOON	Fill Out Chart (Behavioral Activity Monitor & Points) Eat Lunch PowerRelaxationNap (PRN; Use Tape) Perform Activity or Chore (Choose from Menu)
	EVENING	Eat Dinner PRN (PowerRelaxationNap; Use Tape) Engage in Evening Activity 10:00pm: Complete Chart (Behavioral Activity Monitor & Tally Pts) Shower (if not done in am; or, again?) Watch TV News Prep for Bed (PJ's, Brush Teeth, etc.) BedTime		
Clean Appartment	KITCHEN	Fill Out Chart (Behavioral Activity Monitor & Points) Clean Countertops Daily Sweep Floor Daily Organize Cabinets & Wipe off Ice Box Every Weds Mop Floor & Wipe Walls	BEDROOM	Fold clothes or hang them up and store where appropriate. Daily Sweep and vacumn floors when appropriate or prn Organize computer area Empty cat box daily Mop floors when appropriate prn
	DEN	Sweep floor Vacuum daily etc...		

TABLE 2 Task Analysis Samples (continued)

Single Male Professional Chores CheatList

Bathroom	GENERAL	Dust around the Mirror and Light and Window, including the tops of the light and mirrors and window sills. Dust, with a damp cloth, around the windows ills, on the front of the blinds and the back (reverse sides by adjusting slats up and down), and along the tile division.
	TUB & TOILET	Wipe down the bathtub walls, going to the ceiling. Use cleanser and a brush to quickly wipe grime in the tub, and scum stains on the wall. Use soapy brush to quickly wash and rinse the inside shower curtain. With a soapy disinfectant, clean the toilet top, seat, behind the seat, and under the seat, along the walls to the floor Fold all towels neatly on the towel racks
	FLOOR	Sweep the floor, including behind the toilet. Take out the rug and shake it off of the porch vigorously to remove dirt and dust. Remove and empty the garbage can. Mop the floor, using ammonia or Clorox and be sure to get behind the toilet. Use a rag to get the floor behind the toilet. Be sure to get in all the nooks and crannies along the edges of the floor, near the tub, etc.
Living Room		Dust Furniture, including all shelves Use broom/duster to dust along all baseboards, window sills, ceiling molding & fireplace mantle Sweep and Vacuum Under Rugs Sweep and Vacuum Floors Vacuum the couch, love seat, and chair
Kitchen		Empty Trash Can Clean Top of Refrigerator and Microwave (Wet Soapy Cloth) Clean Inside Refrigerator and Microwave Wash Any Dishes and Clean Sink with Cleanser Clean Sink and Surrounding Countertop Sweep, and then Mop Floor
Bedroom		Dust dresser tops, around doors and windows, and along baseboard and ceiling molding Same for Study/Office and Dining Room...
Laundry		9:00am Saturday: Take Clothes to Dry Cleaners before 10:am 5:00pm Saturday: Pick up clothes from Dry Cleaners and Arrange in closet 10:00am Sunday: Launder socks, underwear, bathroom towels, bed sheets, etc. 11:00am Sunday: Use Dryer & Fold & replace clothes when done. Hang Dry other clothes 11:20am Sunday: Steam mist to refresh any pants, shirts in need Sunday 9:00pm: Fold, hang, put away dry clothes
Cleaning Schedule		A: Daily duties: Straighten up each room B: Calendar: Bathroom and Floors on Tuesday pm__; LR, Kitch on Wed pm__; Study, Dining, BR on Sat am__

TA Samples: Daily Activity Trainers

DH's Daily Plan Checklist	1. MORNING	Wake 6:00 AM to the Alarm Clock Take Medication Make Bed Shower Get Dressed Comb Hair Make and eat breakfast Clear, rinse, stack breakfast dishes (for pm wash) Wipe counter, table stovetop if needed Feed animals Brush teeth Gather items to take for the day Leave house at 7:00; go to Grandma's	2. REHAB CENTER	Arrive between 7:30-8:00Am by van Follow Morning Schedule (In Rehab SchedBook) Lunch at 11:30, Take medication Follow Afternoon schedule Leave for Grandma's between 3:30-4:00
	3. LATE AFTERNOON	Dinner at Grandma's & take medication Home between 6:00-7:00PM Get mail, read & sort; put bills on microwave	4. EVENING:	PREPARE FOR THE NEXT DAY Laundry if needed (clothes, sheets,bath/kit towels) separate colors and whites set water level put soap in put clothes in turn on put clothes in dryer - set timer for 45min Listen for Buzzer - fold when dry PUT CLOTHES AWAY: Drawers/Closets
	5. KITCHEN	wash dishes wipe off countertops, stovetop; rinse out sink sweep floor; mop if needed Change or empty cat litter if needed Vacuum Carpet/Rugs if needed Dust Furniture if needed	6. BATHROOM: if needed	clean sink, tub, countertop put toilet cleaner in toilet clean floor, mirror wash toilet inside and out change towels, mat, washcloths Check off things needed on list; write out list when going shopping -Keep list in kitchen drawer Pick & lay out clothes to wear for the next day
	7. FREE TIME	Relax	8. PREPARE FOR BED	Floss/Brush Teeth Wash Face Shave Put away clothes (in hamper or drawer/closet) Set Alarm for 6:00AM

Importantly, the ingredients for rebuilding these automatic habits are the 3 P's: Plan, Practice, Promotional Attitude. The result is rehabilitation, or removing obstacles to independence while achieving incremental progress toward important goals.

learning procedures are learned. This greatly simplifies the learning process.

VI. Functional Task Analyses Model

Task Analysis involves breaking any task or chore or complex procedure into single, logically sequenced steps and, typically, recording the steps in a Checklist (Jonassen, Tessmer, and Hannum, 1999). The checklist allows checking off each step as it is completed. Task analyses always make task initiation, completion & follow through much easier. Performing a Task Analysis and generating a checklist can greatly improve ability to perform tasks in persons with limitations in memory, attention, energy, initiative, ability to sustain performance, organization, or almost any other difficulty (Martelli, 2003).

Task Analysis Checklists are also extremely useful in minimizing fatigue by reducing the demand for, and energy consumed by reasoning and problem solving associated with planning, organizing & having to recall, make decisions & prioritize appropriate steps and sequences for a task. Task analyses are useful for both basic and complex behaviors. Most importantly, Task Analyses allow re-establishing the efficient routines that make up normal everyday human behavior and activity. When the procedures assisted by Task Analyses are repeated consistently, they eventually become automatic [habits] and become as natural as tying a shoe. Samples of task Analyses are included in Table 2.

Further illustration of the conceptual differences between traditional rehabilitation models and methodologies versus newer neurorehabilitation models is offered in Table 3 (Martelli, 1999). Model 1 is based on education and physical rehabilitation models, while Model 2 represents the post acute neurorehabilitation models from which HHR is generated.

VII. Application of HHR Principles and Strategies

An especially illustrative example of the early development of HHR comes from the example of JF, a 39 year old woman who was first seen 2.5 years status post craniotomy for resection of a very large pituitary adenoma that resulted in complete blindness, amnestic syndrome and numerous vegetative-metabolic disturbances. This former architect showed severe memory problems at 2.5 years post injury, was unable to recall the route out of the bathroom in the house in which she grew up and returned to be taken care of by her parents, was only able to conduct over learned activities of daily living with assistance. She had just been discharged from the state school for rehabilitation of the visually impaired due to inability to show any benefit from training. Virtually all health and rehabilitation professionals had deemed her incapable of new learning and recommended that her elderly parents institutionalize her. JF was seen at that time for a more focal and supportive approach to memory rehabilitation screening. Previously unable to demonstrate recall of any new information after 10 to 20 seconds, her memory was assessed in a relaxed atmosphere during discussion invoking her more intact remote memory. Numerous repetitions of the examiner's name were conducted while recall was subsequently prompted after one minute with calming self talk and the following repeated phrases: "Patience, persistence, coax it out gently, build

TABLE 3

A comparison of Traditional Rehabilitation Versus Newer Neurorehabilitation Models

FEATURE	MODEL 1	MODEL 2
Treatment Theory Base	Acute Rehabilitation Outpatient Rehabilitation Day Rehabilitation Physical / Industrial Rehabilitation Traditional Education	Post-Acute Neurorehabilitation Transitional / Community Reentry Neurobehavioral Rehabilitation Executive Skills Rehabilitation Progressive Special Education
Treatment Targets	Isolated Component Behaviors	Complex Behaviors
Treatment Goals	Restoration of Absent/ Deficient Behavioral Components	Compensation - Emphasis is with Integrating Complex Behaviors and Executing Complex Sequences
Treatment Method	Stepwise Component Skills Building	Task Analysis Based Compensation
Treatment Model	Simple - Assumes Sufficient Patient Skills, Participation & "Motivation" - *Primary Determinants of Outcome are Patient Variables*	Complex - Assumes Neurobehavioral & Executive Deficits, Catastrophic Reactions, Deficient Coping; Requires Specialized Behavioral Treatment Skills - *Primary Outcome Determinants are Program, Therapist Variables*
Therapist Role	Expert: Instruct, Direct, Teach Patient, Family Members	Reference/Collaborator: Guide & Shape Behavior of Client, Family Members, Life Skills Tutors (LST's), Liaisons, etc.
Prerequisite Therapist Skills	Technical Skills Competence in Physical Medicine & Rehab Disciplines	Technical & Behavioral Skills Competence (with personal adjustment, emotional stability & flexible problem solving style)
Treatment Setting	Analog - Tx exercises mimic class room, often reflect remote simulations, and offer indirect rewards	Real Life - Realistic, relevant Tx exercises with rewards that mimic life & are inherently rewarding *to Client*
TX Schedule	Part-time, during the work day	24 hours/day, Everyday
Ecological Validity	Training Setting and Functional Goal Relationships are Often Indirect	Training Setting and Functional Goal Relationships are Direct & Apparent
Vocational Training	Train & Place - Assumes Generalizability; e.g. Traditional VocRehab, Work Hardening	Place & Train - Assumes Specificity of Learning; e.g., Supported Employment
Outcome Measures	Performance on: a. Training Tasks in the Rehab Center b. Standardized Neuropsych & Other Office Tests	Performance on Everyday Activities: a. Home b. Workplace c. Community

yourself up, don't beat yourself up...if it comes it will come in calmness and that will be okay, and if it doesn't, that's very, very good too, because you persisted without quitting and you have the best persistence I've ever seen", along with lots of support, encouragement and instruction to breath slowly and deeply. Notably, this patient demonstrated her first documented successful recall of new information at about five minutes. Her second documented recall was that her memory had worked and that she had been able to eventually recall something, even if she couldn't recall what. Over the next two years, with only twice weekly outpatient group attendance, and once to twice a week tutoring form a humorous and friendly volunteer, and instruction of volunteer and mother in repetition (e.g., "Three-Peat" - a timely term after the Chicago Bulls had won three consecutive NBA championships) and association enhancement strategies and "tiny step" expectations with positive shaping and liberal praise, she slowly showed increasing recall for more and more information. Increasing social activities were especially facilitative as they seemed to reawaken this previously very gregarious woman. During outpatient group attendance, she contributed to development of the "Five Commandments of Rehabilitation" by offering inspirational one liners which she coined or borrowed from Sunday television preachers.

At four years post injury, she was re-accepted at the state school for the visually impaired for a one week evaluation for ability to benefit from a typing recording device. She essentially learned the basics of the device during the evaluation, to the staff's true amazement. Two years later, she was typing 60 words a minute and had learned to use adaptive text-voice equipment and was volunteering and applying for jobs with the assistance of a job coach.

JF's case was conceptualized in terms of the suppression of memory by the subterranean catastrophic emotion experienced every time she attempted to recall information. JF was undoubtedly sensitized to distressful emotion by her blindness and in her repeated confrontations with it due to amnestic syndrome. JF could not be expected to endure the continued excruciating distress that must accompany repeated failed recollection efforts without expectation of success. However, when recollection efforts were incremented for a single, simple piece of socially relevant information and strongly supported through emotionally calming talk, it was discovered that she did possess at least some memory storage capacity with ability and some slow retrieval capacity after about five minutes. She subsequently recalled that her memory could work given patience, and this experience ushered in a hope that undoubtedly transformed JF through application of hopeful self talk that is now transcribed in the "5 Commandments" that she contributed to.

In addition to JF, a couple of other illustrative HHR case studies are included on the Villa-Martelli Disability Resources webpage, including an especially interesting one involving rehabilitation of severe dorsolateral frontal lobe based initiation problems (Martelli, Siegal and Zasler, 2002). Although space limitations do not allow review or discussion of other case studies, or even many specific HHR strategies, an instructive introduction to building rehabilitation protocols using the "3 P's" approach is included in Figure 1. The included protocol segments illustrate samples of application of task analytic derived, errorless learning based skills building protocols (the Plan), individually adapted reinforcement via a palatable cognitive attitudinal approach for countering inherent resistances to strategy utilization and practice (the Practice and Promotional attitude components) and promoting incremented goal achievement and reinforcement from graduated successes. Complete protocols and a larger sample of illustrative adapted strategies can be downloaded from the Villamartelli Disability Resources website (Martelli, 1999; 2000-2004).

VIII. CONCLUSION

HHR proposes a "habit" (instinct replacement) model of brain function and a "habit retraining" model of rehabilitation. It postulates that a major learning function of the brain involves "habit" manufacturing - that is, converting repeated behaviors that are functionally adaptive into efficient habits. For example, it is adaptive to remember how to walk, so the sequences involved in walking are chained together in a task analysis that makes it automatic so that performance requires minimal thought and energy. The same conversion occurs when such habits as attentional focusing, memory and multi-tasking are acquired and automated through chaining of the component steps. Through learning, tasks such as internally incorporating the tasks involved in getting dressed, or remembering what to take with us when we leave the house, or "who, what, when, where, how and why" in reading, or the "where we are going, what we are taking with us", are acquired as habits through natural task analysis that sequences behaviors as if we were learning automatic task inventories. The same is true for self control habits ranging from initiation and awareness to inhibition, which involve the very complex chaining of multiple tasks to produce the highest level executive skills habits.

Brain injury can significantly disrupt these previously acquired habits. It can remove general efficiency, greatly tax attention, sequencing, memory, reasoning and energy. It can decompensate adaptive functioning across a wide range of previously automatic skills. The "habit retraining" model posits that by performing and repeating the task analytically derived protocols for these functions, effective learning chains can be reestablished and automaticity achieved. In HHR, retraining methodologies are essentially task analysis derived (http://go.to/MFMartelliPhD) and these constitute the Plan of rehabilitation. Practice is the retraining vehicle for rehabilitation, and the most effective learning procedures are required. Finally, significant emotional responses to losses are conceptualized as the primary obstacle to relearning and rehabilitation. Hence the incorporation of psychotherapeutic principles is posited as an integral component for emotional desensitization and optimizing participation and benefit from rehabilitation strategies. Models similar to HHR allow an almost endless number of individualized facilitative attitudinal protocols to be designed to help optimize rehabilitation process and outcome.

HHR parallels other holistic neuropsychotherapy models, but bears some notable distinctions. It is a parsimonious model – it is relatively simple to understand and apply and can even be summarized in this short paper. It offers an uncomplicated and intuitively appealing model and method for devising and individ-

ualizing specific retraining protocols. Protocols exist for a broad range of relevant skills areas that afford utilization of intuitively appealing internal and external prompts and posters. Most importantly, HHR extends recognition of the importance of neuropsychotherapy by synchronizing it to compatible learning methods, integrating it as an integral and inseparable part of the rehabilitation process and exporting it to rehabilitation therapists and family members. HHR empowers therapists and family members as agents armed with highly potent neurorehabilitation specific learning and psychotherapeutic strategies. Finally, HHR's purpose is to expand neuropsychotherapeutic rehabilitation beyond simple emotional adjustment and functional compensation to include promotion of neuroplastic based rehabilitation of cognitive, behavioral and physical capabilities.

To download a complete presentation on HHR by the authors of this article, visit: www.nabis.org/hrr

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