THE NEUROBIOLOGY OF HABIT AND BEHAVIOR CHANGE

CALIFORNIA PSYCHOLOGICAL ASSOCIATION CONFERENCE APRIL 2017

Kenneth Nowack, Ph.D.
Envisia Learning, Inc.
www.envisialearning.com
ken@envisialearning.com

envisia LEARNING

WHO WE ARE

Kenneth M. Nowack, Ph.D. is a licensed psychologist and Co-founder of Ofactor. Dr. Nowack received his doctorate degree in Counseling Psychology from the University of California, Los Angeles and has published extensively in the areas of 360-degree feedback, assessment, health psychology, and behavioral medicine. Ken serves on Daniel Goleman's Consortium for Research on Emotional Intelligence in Organizations. He serves as Associate Editor for the APA journal *Consulting Psychology Journal: Practice & Research*.

@envisia

envisia LEARNING

The Neurobiology of Habit Change

- The Necessary Ingredients for Behavior Change
- The Challenge of Acquiring and Sustaining New Behaviors
- How Long Does it Tale to Change a Habit? Introduction to Neuroplasticity
- Questions

@envisia

envisia LEARNING

What are the necessary conditions to initiate and successfully maintain new behaviors?

@envisia

envisia LEARNING

Necessary Ingredients for Behavior Change

Mashihi & Nowack (2013)

@envisia

envisia LEARNING

hab·it

A BEHAVIOR DONE WITH LITTLE OR NO CONSCIOUS THOUGHT

Habits Exercise

Write your signature with your non-dominant hand

@envisia

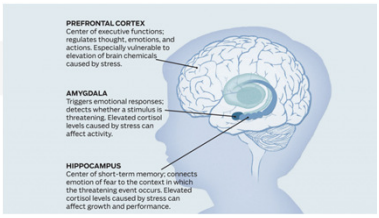
Habits are Hard to Change…Harder to Sustain

- ***NEW YEARS RESOLUTIONS***: >25% abandon new behaviors after 15 weeks; 60% make the same resolution the next year (Marlatt,1996)
- ***WEIGHT LOSS***: About 2/3 of those who lose weight regain it all back within 4-5 years (Mann, 2007)
- ***SMOKING***: 40% of those who try were not able to quit for even 1 day (Messer, 2008)
- ***ALCOHOL***: 90 percent of alcoholics are likely to experience at least one relapse over the 4-year period following treatment; remission rates to range from 50 to 80% or more, depending on the severity of alcohol problems (Moos, 2006)
- ***DUI/DWI:*** 25-33% are repeat offenders and 40-70% have prior offenses
- ***PRISON RECIDIVISM***: Within 3 years of release 67.8% return and within 7 years 76.6% return/82.1% for robbers (Eichinger, 2017)
- ***LEADERSHIP CHANGE***: Meta-analysis of 26 longitudinal 360 studies indicate significant but small effect sizes (Smithers, 2005)

@envisia

The "Force" Vs. The "Dark Side"

CHRONIC STRESS *DECREASES* ACTIVATION OF THE VENTROLATERAL PREFRONTAL CORTEX AND *INCREASES* THE ACTIVATION OF THE AMYGDALA

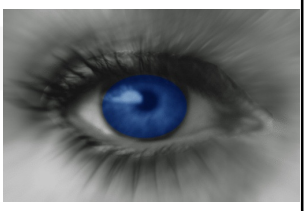


@envisia

Our Tesla Self-Driving Brain

Activating the primary threat and reward circuitry takes 1/5th of a second

Rock, D. (2008). SCARF: a brain based model for collaborating with and influencing others. *Neuroleadership Journal, 1*, 1-9



@envisia

Our Auto-Pilot Brain I

Automaticity

40-80% of what anyone does is **automatic** and not influenced by new thinking or problem solving

Left to its own, the brain would like to make everything **automatic** so it doesn't have to think (PFC) to act.

The rest of the brain thinks the PFC is **too slow**

@envisia

Our Auto-Pilot Brain II

The brain faces thousands of issues and decisions everyday

The **brain creates shortcuts** (heuristics) that execute a set of sequenced stored automatic behaviors Creates automatic responses to common situations

Takes **4-7 repetitions** to form a **beginning heuristic**

To change, you have to form stronger brain circuits to override existing ones and/or create better ones

Wary Herbert (2010). *On Second Thought: Outsmarting Your Mind's Hard-Wired Habits*, Crown Publishers

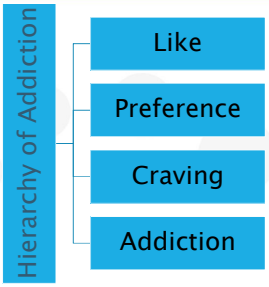
@envisia

Why It Is So Hard to Change Behavior

Most of the **embedded routines** that exist are satisfying to the reward centers of the brain and will be kept and repeated until the **need to stay the same** is overpowered by **the need to change**

@envisia

Reinforcing Rituals (Addictions)



@envisia

Reinforcing Rituals (Addictions)

- **Dopamine** is the neurotransmitter in charge of pleasure
- When you experience pleasure **dopamine is released** to the reward center (nucleus accumbens) and then sent to the memory center (temporal lobe)
- **Serotonin** is the neurotransmitter primarily responsible for regulating moods/emotions and *low levels* are associated with depression and/or obsessive/compulsive behaviors
- People with ***low levels* of serotonin** are attracted to alcohol and opiates that increase the level

@envisia

Principles of Neuroplasticity

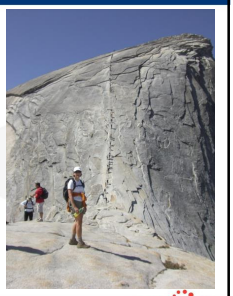
Kleim & Jones (2008)

Use it or Lose It	Failure to activate certain brain functions causes loss
Use it and Improve It	Training targeting specific brain areas enhance functioning
Specificity Matters	The nature of the behavioral rehearsal dictates specific neuroplasticity
Repetition Matters	Plasticity requires sufficient *varied* repetition
Intensity Matters	Sufficient intensity facilitates plasticity
Time Matters	Different kinds of plasticity occur at different times in training
Salience Matters	Training must be sufficiently salient to foster neuroplasticity
Age Matters	Training induced plasticity occurs more readily in younger brains
Drivers Matter	Some activities coupled with learning facilitate greater neuroplasticity (e.g., exercise and sleep)

@envisia

Neuroplasticity, Skill Practice & Exercise

- *Timing is Important*: Those who exercised **four hours after** their learning session retained the information better *two days later* than those who exercised either immediately or not at all (Van Dongen et al., (2016)
- A meta-analysis of 29 studies links the role of exercise with an increase in BDNF (Szuhany et al., 2014). BDNF is associated with learning, memory and thinking (Voss et al., 2013; Gomez-Padilla, 2008)
- BDNF levels *significantly increased* after 2-3 minute sprints and compare with sedentary or moderate exercise conditions participants showed a *20% increase* in the speed of recall of words immediately following their intense exercise (Winter, et al., 2007)
- *Length is Important*: A 30-minute aerobic exercise break in teenagers resulted in a significant improvement with *on-task attention* compared to a 5-minute break (Kubesch, et al., 2009)



@envisia

Neuroplasticity, Skill Practice & Exercise

- The posterior hippocampus (visual-spatial memory center) of London taxi cab drivers has been shown to *increase* with years of experience (Maguire et al., 2000; Woollett, et al., 2009)
- Adults attending a juggling course showed detectable changes in brain structure in 3-months (Draganski, et al., 2004)
- Individuals with *previous* video game experience have better video-endoscopic surgical skills (Grantcharov et al., 2003) and laparoscopic surgeons who had played games in the past and were playing games now made 37% and 32% *fewer errors*, respectively (Rosser et al., 2007)

@envisia

Neuroplasticity and Sleep

Across an 85-year life span, an individual may sleep nearly *250,000 hours* or over *10,000 full days*

- Tissue restoration (Adam & Oswald, 1977)
- Brain-metabolite (β-amyloid) clearance (Xie et al., 2013)
- Activation of genes involved in creating of oligodendrocyte precursor cells or myelin (Bellesi et al., 2013)
- Stabilization and integration of memory (Scullin et al. 2015)

Neuroplasticity and Sleep

- *Two hours less* sleep than you need is enough to impair your performance as if you've been drinking 2 to 3 beers and had .05 blood alcohol level and getting *only 4 hours* of sleep is equivalent to being legally drunk in most states (.10%) on psychomotor vigilance tests (Roehrs et al., 2003; Williamson & Feyer, 2000)
- Netlag: Use of smartphone/tablet screens (blue light) at night *delay* the brain's production of the hormone melatonin and impact sleep quality and length Chang et al., 2014; Higuchi et al., 2005; 2003)
- A NASA study found that a *26-minute nap* improved performance 34% and alertness 54% and a 60-minute nap improves alertness for 10 hours (Rosekind, et al., 1995)

Personality and Habit Change I

- Leaders high in *extraversion* were **significantly more likely** to have sought additional feedback (London & Richmond, 2005)
- Leaders high in *conscientiousness* were **more likely** to have actually *engaged in developmental behaviors* (Klockner & Hicks, 2008)
- *Extraverted* leaders who were also high on the personality factor of *openness to experience* were **more likely** to perceive and view negative feedback as valuable data and were *most likely* to seek further information (Bell & Arthur, 2008).
- Individuals with high levels of ***core self-evaluations*** (those with *high self-esteem, generalized self-efficacy, internal locus of control and low neuroticism*) will be **most motivated** to initiate behavior change when they receive discrepant feedback (Bono & Colbert, 2005)

Extraversion	• Friendliness, Gregariousness, Assertiveness, Activity Level, Excitement-Seeking, Cheerfulness
Agreeableness	• Trust, Morality,Altruism, Cooperation, Modesty, Sympathy
Conscientiousness	• Self-efficacy, Orderliness, Dutifulness, Achievement-striving, Self-discipline, Cautiousness
Neuroticism	• Anxiety, Anger, Depression, Self-consciousness, Immoderation, Vulnerability
Openness to Experience	• Imagination, Artistic Interests, Emotionality, Adventurousness, Intellect, Liberalism

Personality and Habit Change II

- Across four decades of adulthood in the Terman Life Cycle Study, ***neuroticism*** was most predictive of ***subjective well-being***
- Only ***conscientiousness*** is significantly predictive of **longevity** (the most objective measure of health)

Turiano et al. (2015). Personality and the leading behavioral contributors to mortality. *Health Psychology, 34,* 51-60

Friedman et al. (2014). Personality well-being and health. *Annual Review of Psychology. 65,* 719-742

- Only low ***conscientiousness*** (reflecting low persistence, poor self-control, and lack of long-term planning) is associated with elevated **mortality risk** when taking into account age, sex, ethnicity, nationality, and all FFM personality traits

Jolela et al., (2013). Personality and all-cause mortality: individual-participant meta-analysis of 3,947 deaths in 76,150 adults. *American Journal of Epidemiology, 178,* 667-675

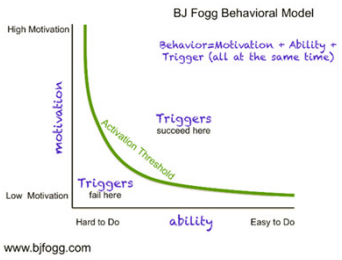
Motivational Drivers of Habit Change (Fogg, 2000)

1. Seeking Pleasure
2. Avoiding Pain
3. Seeking Hope
4. Avoiding Fear
5. Seeking Acceptance
6. Avoiding Rejection

Motivational Barriers of Habit Change

- Time
- Money
- Cognitive/Physical Effort
- Social Support
- Biological Rhythms
- Non-Routine (Unknown stimulates *amygdala arousal*, interferes with focus and decreases engagement)

The Psychology of Habits

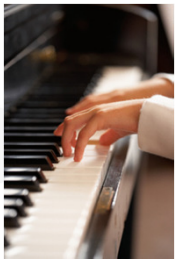


Steps to facilitate *successful* behavior change (in order of relevance for success:

1. Create a meaningful ***trigger***
2. Modify the **difficulty level** to carry out the behavior (i.e., make it easier to do)
3. Influence the **readiness to change** (motivation level)

Challenge #1 Acquiring New Behaviors

- Frequently people underestimate the difficulty of sustained behavior change
- A key to developing and enhancing new skills is *varied* deliberate practice (Celnik, 2016)
- There are different predictors of non-intenders to successful adopters (e.g., readiness to change) versus unsuccessful maintainers versus *successful maintainers* (e.g., perceived control and efficacy)



Rhodes, Plotnikoff & Courneya (2009)

Challenge #2 How Long It Takes to Form a Habit

Neuroplasticity

Research suggests that significant *neural changes* occur with 3-12 weeks of new behavioral change efforts

Tang, Y-Y. et al., (2012)

Days to Become Automatic

The number of days it takes for a new behavior to become "*automatic*" depends on its complexity (e.g., new eating habits take 65 days and exercise 91 days)

Lally et al., 2009

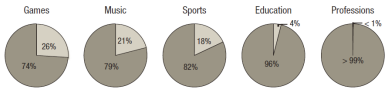
Urban Myth #1: The 10,000 Hour Rule

Recent meta-analytic research (157 effects sizes and over 11,000 participants) testing the "10,000-hour rule" does not support this *urban myth*

Deliberate practice accounts for little variability (26% for games and less than 1% for career success) in actual performance relative to ability set-points

Macnamara, B. et al., (2014). Deliberate Practice and Performance in Music, Games, Sports, Education, and Professions: A Meta-Analysis. *Psychological Science, 25*, 1-11, doi:10.1177/0956797614535810

Hours of Practice



Urban Myth #1: The 10,000 Hour Rule

- A **meta-analysis of 33** studies explored the relationship between deliberate practice and sports performance
- Practice and performance were positively correlated (r = .41)
- 18% of the variance in sports performance was attributable to **deliberate practice** across all skill levels but for **elite athletes** this variance was **only 1%**
- The amount of variance in performance that cannot be attributed to practice highlights the need to consider other factors that contribute to developing expertise

Macnamara, B., Moreau, D, & Hambrick, S. (2016). The Relationship Between Deliberate Practice and Performance in Sports: A Meta-Analysis. *Perspectives on Psychological Science, 11*, 333-350

Challenge #2: Genetics + Practice Makes Better

- 10,500 Swedish identical and fraternal twins were evaluated on music ability (rhythm, melody, and pitch discrimination) and practice time
- More music practice **was** significantly associated with **better** music ability (rs = .18–.35)
- Once all **genetic and shared environmental factors** were controlled for, the association between music practice and ability **disappeared**
- Genetic variation among individuals affects both **ability and inclination** to practice (music practice was substantially heritable; 40%–70%)

Mosing, et al., (2014). Practice Does Not Make Perfect: No Causal Effect of Music Practice on Music Ability. *Psychological Science, 7*,1-9.

- Across a wide range of piano-playing skill, deliberate practice accounted for nearly half the variance (45.1%) in sight-reading performance in the study
- However, working memory capacity (which is highly stable and heritable) accounted for a *significant proportion* of the variance (7.4%), **above and beyond deliberate** practice

Heinz & Hambrick (2010). Deliberate Practice Is Necessary but Not Sufficient to Explain Individual Differences in Piano Sight-Reading Skill: The role of Working Memory Capacity. *Psychological Science, 21*, 914-919

Challenge #2: How Long It Takes to Form a Habit

- Practicing mindfulness meditation for 4-8 weeks demonstrated significantly higher ***white matter neuroplasticity*** changes compared to a control group
- Participating in a 8-week (27 minutes per day) mindfulness meditation programs created significant changes in brain regions associated with memory, sense of self, empathy and stress compared to control groups (e.g., PFC, amygdala, cingulate cortex)

Tang, Y-Y., et al., (2012). Mechanisms of white matter changes induced by meditation. PNAS, doi: 10.1073/pnas.1207817109

Gotlink et al., (2016). 8-week Mindfulness Based Stress Reduction induces brain changes similar to traditional long-term meditation practice – A systematic review. Brain and Cognition, 108, 32-41

Hölzel, B., et al. (2011). Mindfulness practice leads to increases in regional brain gray matter density. Psychiatry Research: Neuroimaging, 191 (1): 36 DOI: 10.1016/j.pscychresns.2010.08.006

Hölzel, B., et al. (2015). Psychiatry Research: Neuroimaging http://news.harvard.edu/gazette/story/2011/01/eight-weeks-to-a-better-brain/

Challenge #2: How Long It Takes to Form a Habit

- 12 Participants participated in a 12-week program listening to a meditation based self-hypnosis tape before bedtime
- Significant reductions in the inflammatory cytokine *IL-6*, self-reported *stress* and use of negative appraisal *coping* were found

Schoen, M. & Nowack, K. (2013). Reconditioning the Stress Response Reduces the Inflammatory Cytokine IL-6 and influences resilience: A Pilot Study. *Complementary Therapies in Clinical Practice, 19*, 83-88. doi: 10.1016/j.ctcp.2012.12.004

Challenge #2: How Long It Takes to Form a Habit

- 121 patients with multiple sclerosis were randomized to receive stress management therapy or a wait-list control condition (16 individual sessions over 24 weeks with follow-up in 24 weeks)
- The stress management group showed significant decreases in new gadolinium-enhancing (Gd+) brain lesions on MRI at weeks 8, 16, and 24 and no new or enlarged T2 MRI lesions
- The benefit was not sustained beyond 24 weeks, and there were no clinical benefits after the program ended

Mohr, D. et al., (2012). A randomized trial of stress management for the prevention of new brain lesions in MS. *Neurology, 79*, 412-419.

Challenge #3: 70/20/10 Rule for Development (CCL)

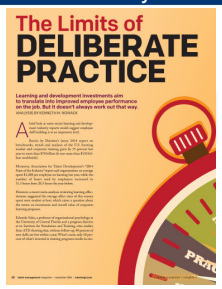
Experience
- Job change
- Special projects and assignments
- Exposure and involvement in key business challenges
- Task forces, committees, change initiatives

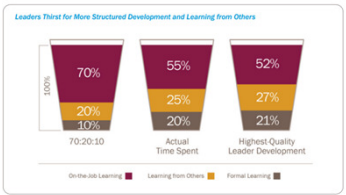
Feedback & Coaching
- Job Performance feedback
- Executive coaching
- 360-degree feedback process
- Developmental assessment workshops

Formal Learning
- Critical skill building training programs
- Transition training programs
- Key external executive programs
- Self-directed learning initiatives

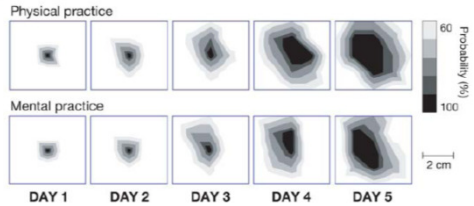
Ascending Value

Urban Myth #2 The 70/20/10 Ratio (DDI, 2015)





Mental Practice Facilitates Behavior Change



Average cortical output maps for the finger flexors of the trained hand in subjects undergoing daily physical versus mental practice of the 5-finger exercise. Note the similarity in output maps with either form of practice Pascual-Leone, 1966)

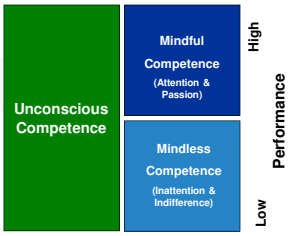
Making Behavior Visible Facilitates Successful Change

Making feedback more visible/tangible enhances focus and success

@envisia

Unconscious Competence and Peak Performance

- Orchestral musicians preferred creating music when they were encouraged to mindfully incorporate subtle nuances into their performance
- Audience members were played recordings of both types of performance and a *significant* majority expressed a preference for the performances that were created in a mindful state
- The practice of staying acutely aware of what is happening in the present moment prevents *mindless competence* and the use of *mindful competence* increases creativity, productivity and engagement



Langer, E., Russel, T. & Eisenkraft, N. (2009). Orchestral performance and the footprint of mindfulness. *Psychology of Music, 37*, 125-136.

@envisia

The Psychology of Choking

- Choking is **not just poor performance**--it is performing more poorly than expected, given one's skill level, in situations where performance pressure is at a maximum
- Pressure can *compromise* performance by:
  - Interfering with attention and memory resources with *distracting* worries about the quality of performing
  - Increasing *self-consciousness* which disrupts the execution of habits that normally run outside of conscious awareness

DeCaro, M. S., Thomas, R., Albert, N. B., & Beilock, S. L. (2011). Choking under pressure: Multiple routes to skill failure. *Journal of Experimental Psychology: General, 3*, 390-406

@envisia

Challenge #4: Health Benefits of Quitting

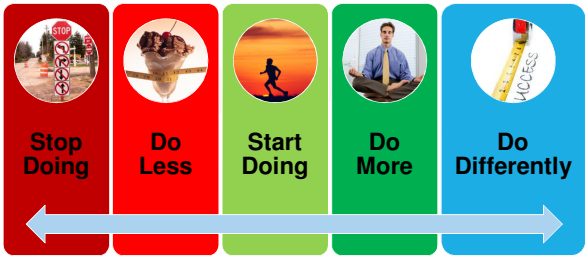
- Individuals who *did not* persist obtaining **hard to reach goals** had:
  - Significantly lower inflammation (C-reactive protein)
  - Decreased cortisol secretion
  - Higher sleep efficiency
  - Decreased emotional distress
  - Lower self-reported cold symptoms
- It may be more prudent to cut one's losses in the face of an insurmountable obstacles to remain healthy

- Miller, G. & Wrosch, C. (2007). You've Gotta Know When to Fold 'Em: Goal Disengagement and Systemic Inflammation in Adolescence. *Psychological Science, 18*, 773-777.
- Wrosch, et al., (2007). Giving Up on Unattainable Goals: Benefits for Health? *Personality and Social Psychology Bulletin, 33*, 251-265

@envisia

15 Goal Setting Options (BJ Fogg, 2004)

One Time—Sometime—All The Time



@envisia

The Psychology of Goal Setting

1. People are more likely to engage a goal when they have set a ***high-low range goal*** (e.g., lose 2–4 pounds this week) than when they have set a single number goal (Scott & Nowlis, 2013)
2. People who write their goals, *share* ***their commitment*** with others, and send weekly progress reports accomplish were 33% more successful than those who did not write their goals or share intent and progress (Matthews, 2012)
3. **Writing out** a detailed plan works well for participants when they focused on a **single goal** but *not multiple goals* (Dalton & Spiller, 2012)
4. *Goal intentions* are weak predictors of actual behavior change but people who create **implementation intentions** are ***significantly*** more likely to actually be successful in completing the goals (Gollwitzer, 1999)

@envisia

Challenge #5: Creating Practice Plans

- Goal intentions alone do not always result in successful maintenance of behavior over time (Lawton, Cooner, & McEachan, 2009)
- SMART goals aren't always that *smart*
- Format is important! "If-then" statements maximize success
- Behavior must be observable and measurable
- Nearly a hundred studies have shown that *Practice Plans* double a person's likelihood of achieving their goals (Gollwitzer & Sheeran, 2006)

Facilitating Neuroplasticity Through Practice Plans

Practice Plans have two parts.

1. The first is the situation, or the trigger, where you'd like to behave differently
2. The second part is what you commit to do more, less or differently when you experience the trigger

Creating Practice Plans (Gollwitzer & Sheeran, 2006)

Goal Intention Example

- *"To stay calm in anxiety producing situations"*

Practice Plans Example

- *"**If** my heart starts to race, **then** I will begin using my breathing technique and focus on how relaxed I begin to feel"*

Selected References

Nowack, K. M. (in press). Facilitating Successful Behavior Change: Beyond Goal Setting to Goal Flourishing. *Consulting Psychology Journal: Practice and Research*.

Nowack, K. M. (2015). The Limits of Deliberate Practice. *Talent Management Magazine, 11, 22-25.*

Nowack, K. M. (2015). Urban Talent Myths Exposed. *Talent Management Magazine, 11*, 35-37, 47.

Nowack, K. (2014). Taking the Sting Out of Feedback. *Talent Development Magazine, 68*, 50-54.

Nowack, K. & Mashihi, S. (2012). *Evidence Based Answers to Ten Questions about Leveraging 360-Degree Feedback.* Paper presented at the SIOP Conference, San Diego, CA.

Mashihi, S. & Nowack, K. (2012). *Clueless: Coaching People Who Just Don't Get It.* Envisia Learning, Santa Monica, CA.

Nowack, K. (2009). Leveraging Multirater Feedback to Facilitate Successful Behavioral Change. Consulting Psychology Journal: Practice and Research, 61, 280-297.

Nowack, K. (1999). 360-Degree feedback. In DG Langdon, KS Whiteside, & MM McKenna (Eds.), Intervention: 50 Performance Technology Tools, San Francisco, Jossey-Bass, Inc., pp.34-46.

Nowack, K., Hartley, G, & Bradley, W. (1999). Evaluating results of your 360-degree feedback intervention. *Training and Development, 53*, 48-53.

Nowack, K. (1999). Manager View/360. In Fleenor, J. & Leslie, J. (Eds.). *Feedback to managers: A review and comparison of sixteen multi-rater feedback instruments (3rd edition).* Center for Creative Leadership, Greensboro, NC.,

Wimer & Nowack (1998). 13 Common mistakes in implementing multi-rater systems. *Training and Development, 52*, 69-79.

Nowack, K. & Wimer, S. (1997). Coaching for human performance. *Training and Development, 51*, 28-32.

Nowack, K. (1997). Congruence between self and other ratings and assessment center performance. *Journal of Social Behavior & Personality, 12*, 145-166.

NNowack, K. (1992). Self-assessment and rater-assessment as a dimension of management development. *Human Resources Development Quarterly, 3*, 141-155.