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Using High Impact Technology to Create Safety Awareness

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Introduction

Locked into rising costs, organizations must find gains through improved individual performance at all levels. Increasing global competition, combined with economic weakness and uncertainty have put unprecedented pressure on commercial businesses, the public sector, and not-for-profits of all types[1].

"Top line" numbers in the form of sales, publicly-funded budgets, and donations all are under the pressure of current economic conditions. In order for organizations to thrive, or even survive, they must create gains from their operational areas.

The people who work within those organizations are subject to their own uncertainties and distractions. Combining these factors with pressure for increased productivity leads to two objectives with respect to occupational safety and health:

1. Protect skills, talent, and experience that are the key resources in making the organization function and work toward mission-critical goals
2. Gain enormous economic benefit by reducing the direct and indirect costs of workplace and off-the-job injuries

Job-related injuries cost over $115 Billion annually[2] or over $315 Million every day on average. In 2006, the U.S. Centers for Disease Control & Prevention (CDC) analyzed lifetime cost of injuries in the United States and reported the astounding annual cost to be $406 Billion[3], well over $1 Billion for every day of the year. The Director of the CDC at that time, Dr. Julie Gerberding commented, "The financial and economic impact of injuries in the United States is serious. However, by expanding our science-based injury prevention programs, we can drastically reduce these costs and even more importantly help people live longer and healthier lives."

For these reasons, executives and managers have been watching and waiting for emerging technologies that can get safety training off the printed page or video monitor, and into realistic experiences known to support the types of individual and group behavior change needed to improve performance in their organizations. New technologies have changed almost every aspect of the way people live their personal and business lives. The purpose of this document is to show how new and emerging 3D media-based technology leads to the same type of dramatic change in workplace safety training, by providing the following information:

1. The difference between short-term motivation programs and long-term behavior change
2. How learning, memory and values affect behavior on and off-the-job
3. How proven, proprietary approaches now allow training to achieve dramatic, long-lasting change by immersing program participants in powerful, realistic experiences
4. Dramatic evidence from logistics and manufacturing workplace settings showing the safety and economic impact of consistent, safe choices by employees and contractors
5. How diligent research and technological advances have made these types of programs available for implementation in organizations of all types

The specific technology under discussion includes 3D stereoscopic video, 3D binaural audio and immersive audio/video headsets.

Persistent morbidity and mortality resulting from occupational injuries frustrate organizations and creates significant economic and talent burden. Adequate safety training on processes and compliance rules typically are in place, yet somehow even veteran employees fail to comply with simple expectations, unless they have had a significant experience that serves to focus their attention and causes them to take potential hazards seriously.

Safety professionals often reflect after tragic incidents and pose to themselves this sequence of questions:

- Could this accident have been avoided?
- Were the employees properly trained?
- Do employees get ample safety training?
- Do we provide effective processes and quality equipment?
- Do employees still get hurt?
- Do employees ***always*** follow the safety rules?
- Why or Why not?

True safety compliance is more than just having appropriate safety process, training, and equipment. The fact that an organization can meet Federal OSHA compliance standards and still have accidents validates this. In order to achieve process compliance, in the face of human variability, stresses, and distractions, there must be more than just meeting Federal compliance standards and motivating the workforce. Full attention to task and processes, fueled by uninterrupted safety awareness, is the key.

Safety awareness can be defined in many ways, each reflecting a different element and point-of-view. The common theme among all of the definitions is the attainment and durability of a state-of-mind of employees that is with them at all times and across all types of situations and environments. The common model known as the “safety pyramid” focuses on the progression of relatively common, imprudent safety choices and near-misses of accidents to the rarer, but tragic fatalities and severe injuries. Most organizations focus on liability mitigation and process review in response to such tragedies. While the majority of individual unsafe choices may not lead to reportable injuries, a pattern of unsafe choices inevitably will fuel a pattern of severe consequences. Organizations continue to invest in training in hopes of reducing human variability in compliance with protocols. Such efforts can in fact have beneficial impact, but typically are not sufficient to fully offset environmental stresses, distractions, and employee indifference. In addition to training itself, organizations commonly blend in program components that attempt to influence employee motivation. These often are referred to as “extrinsic” or “external” incentives, which may be positive or negative in nature.

Benefits and Risks of Extrinsic Reward Systems

Almost all organizations utilize extrinsic reward or punishment systems in an attempt to shift employee behavior. In many cases, this allows for clear definition of goals, clear measurement, and focus upon individual and group effort. The use of extrinsic reward systems dates well back into history, but much of the formal theory comes from the work of behaviorists, most notably B. F. Skinner, and involves a behavior change technique frequently known as *operant conditioning*.[4] The basis is well known in business and organizational management, i.e. reward the behaviors you want; provide a negative reward (punishment) for behaviors that you do not want.

One of the important principles in this approach is that of *reinforcement*. Since the reward or punishment follows sequentially the target behavior, the idea is that the consequence will tend to send the message "do more of that" or "don't do that again." Rules and expectations can be established beforehand, which in turn helps to establish a perception of fairness and clarity.

This approach does have risks however, which break down into three areas:

1. If the task is not well defined, not measurable, or not subject to real-time observation, the approach is not a good fit. It becomes nearly impossible to create clear procedures and to define what is being asked. Even if the task itself has a high degree of consistency, if measuring what happened and who did what is difficult, evaluation for the purpose of the reward system will lose accuracy and may be perceived as arbitrary.

2. Reinforcing the desired behavior pattern with a reward system associates the value of that behavior with the reward. If the reward is not valued by participants, has lost significance over time, or is discontinued, the basis for the behavior disappears.

3. Participants in the program are focused upon the reward, versus on the underlying reasons why they need to make the correct choice. The benefit is external to them. The potential adverse consequence of this will be explored in more depth while looking at how program participants attribute the basis for the behavior of themselves and others, but there is risk that an extrinsic reward system can actually have a demotivating effect[5] and therefore have impact that is the opposite of the intended effect.

Program Impact and the Duration of Positive Change[6]: Compliance and Alignment

In compliance-oriented approaches, employees are given what the organization believes to be enough information to complete assigned tasks, and then are expected to do them. That expectation is reinforced through vigilance, measurement, supervision, increasingly escalated and novel reward or punishment systems – all things external to the employee. For this approach to be successful requires continual investment. The concept of alignment, in contrast, is based upon commonality of value systems. It seeks a shared commitment to meeting organizational and personal objectives.

From an economic standpoint, compliance is an unattractive approach. As it does not cultivate emotional adoption of company values, it requires continual intervention and treats "motivation" as something to be supplied to employees, rather than something that comes from within.

Alignment on the other hand can move toward becoming a self-reinforcing system. Alignment allows employees to behave in ways consistent with company and personal objectives because they believe them to be important. Once that belief is instilled, it can continue over time and across situations. In group settings, individual employees both learn from role models and become role models to others. The modeling not only reinforces the beliefs. It also gives employees confidence and a sense of "self-efficacy" and competence and the ability to get things done correctly. Training that fosters a culture of alignment therefore, reaches employees at the level of values and beliefs.

Emerging Opportunities in Program Delivery and Content

In a very short period of time, telecommunications has become the dominant information and social force. There is a whole new vocabulary, and the Internet brings access, connectedness, and information to everyone. When Nobel Laureate Arno Penzias in the 1980's predicted that computers once hooked together and into the telecommunications system would "change the world,"[7] he accurately portrayed the exceedingly rapid changes in how people communicate and interact with the world around them. Concurrently, Moore's Law[8] forecast that electronics would become faster, more economical, and more powerful. Yet the technology alone has not made people happier, healthier, or more team-oriented. It is how we use it to improve business performance and quality of life that makes the difference.

New technology has been used successfully for delivery of content and information. It can keep you from getting lost, keep you up to date on sports scores, and allow you to hold a conversation with someone around the world. Information is so accessible and so unfiltered that it can be difficult to sort out what is authoritative and what simply is a distraction. Attention to the most critical and valuable information has become a difficult task.

Healthcare is one area where technology has allowed physicians and researchers to learn much more about actual mechanisms in human beings and how they work. The human brain in particular is vastly more complex than any man made device. It still is not possible to "look" into the brain and see exactly what is happening, but one technology has brought us much closer. *Functional magnetic resonance imaging* (fMRI) can record brain activity in real time. There are many areas in the brain, which work together in thinking, perception, emotions, memory, motor control; in fact everything a human being does. Through fMRI, it is possible for the first time to match what is happening externally with internal brain processes, and to think differently about behavior change.

Harnessing the Power of New Media

During the 20th century, audio, video, and broadcast technologies drove rapid evolution in the world of entertainment. The new approaches to bringing programming to audiences allowed for a richness of content that was not possible before. Introducing audio to complement print, then video to complement audio brought an impact to entertainment that had not existed before. Early "stereopticon" machines even allowed for depth perception that gave genuine feel and sense of

motion to video images. Hollywood recognized how to create entertainment and deliver it to stimulate the senses in new ways. It also brought a new experience to the audience. For the first time, the emotional impact and memorability of live performance was accessible to the mass market.

Professor Edgar Dale[9] carried this principle into researched projects and demonstrated the utility of the same content delivery advances for training and education. Often a "cone" is utilized to illustrate the hierarchy of content delivery and experience, and how it impacts individuals.

This formal validation of the power of new methods of content delivery has continued to drive innovation in creating experiences and delivering information. One application that demonstrates the power of being able to deliver content in ways that are perceived as very real has been the "Virtual Iraq"[10] project. Through controlled, repetitive delivery in 3-dimensional formats of scenarios that evoke some of the same responses as those experienced in Iraq or Afghanistan war zones, there have been promising results in terms of helping returning soldiers who are suffering from PTSD (Post Traumatic Stress Disorder).

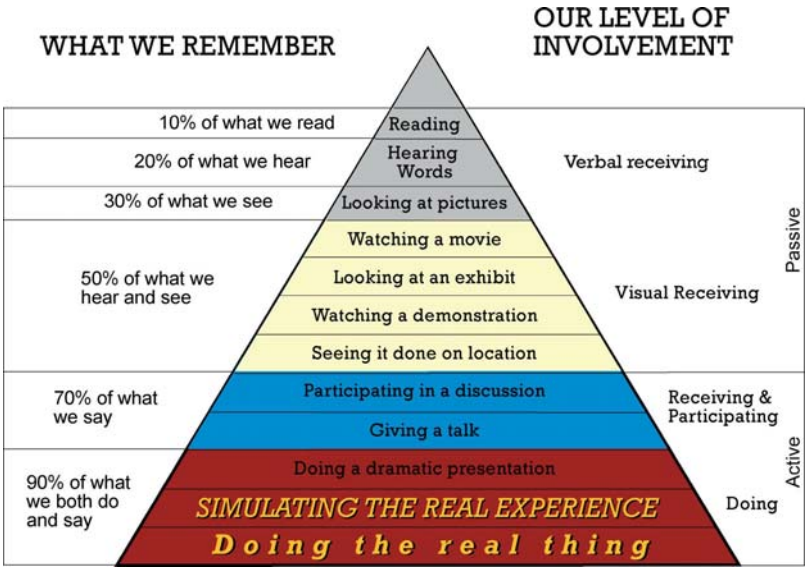

Figure 1. Content Delivery and Experience Cone

The work of Dale and subsequent researchers created the promise for achieving powerful experiences, which could be the basis for durable shifting of an individual's safety paradigm. The content development and enabling technology allow for experiential training without the risk, cost, or time of exposing employees to actual hazardous situations or behaviors. These experiences offer a compelling reason to make change, providing a basis for internally-generated motivation. In doing so, they have changed the safety perception of the trained individual. A shift in perception due to the powerful experiences supports prudent choices, leading to prudent behaviors. When the new pattern reinforces itself and becomes the dominant pattern of behavior at an internal and even unconscious level, it has evolved fully into a *habit.*

Creating an Experience that Leads to Behavior Change

Almost everyone has experienced the connection between the senses; intensity of experience, and personal memory. The technical reason has been well studied. Emotional arousal leads to epinephrine release, activating the vagus nerve and starting a chain of reactions that bring in other brain areas including the amygdala and the hippocampus, which are critical in memory. The enhanced memory is further supported by the release of glucocorticoids (stress hormones). Too high a level of glucocorticoids however may interfere with working memory, and long term stress can damage the hippocampus[11].

The sound of a baby crying, a certain aroma, watching triumph in a sporting event, a piece of music; almost anything that our senses perceive as real may carry powerful associations with it. The horrors of war can be masterfully authored and have impact; but the written word has less impact than graphic photographs; which in turn have less impact than being present or experiencing in a delivered reality situation. Our senses are the points of interaction with the environment. They work in specific ways. Because all of us are inundated with sensory input, we and our brains are trained to pay attention to a few things and ignore the others. In order for key training messages to reach program participants, they must achieve that level of attention. This requires being immersed in the training experience, and eliminating conflicting distractions.

As the vast majority of sensory input in the workplace is via sight and sound, those are the key senses that must be aroused when creating an experience that can lead to behavior change.

Binocular Vision and Binaural Audio

<u>Creating Visual Images</u>
Almost all media utilized in training are limited by delivering content in two dimensions only. This does not match with the way that human beings utilize binocular vision, a capability people have because they have two eyes that look at things from a slightly different angle. The most recognized advantage to binocular vision is depth perception when looking at something real in the environment. The input to the brain reflects the fact that the two images are not identical. The separation of images sometimes is known as *binocular disparity*, and the differences are utilized by the brain to help determine relative depth. Two dimensional images simply represent depth, but do not create the same binocular disparity; therefore they do not match the brain's criteria for recognizing something as real.

It is not only the apparent reality that makes genuine stereoscopic vision critical in behavior change. Studies by vanStrien et al. show that stereoscopic depth cues activate the PER (perirhinal cortex) region, which provides input directly to the hippocampal formation[12]. The hippocampus, as covered above is critical in memory. Straube et al. corroborate a similar point by establishing that cortical and hippocampal activation by binocular stimulation contributes positively to subsequent memory performance. This beneficial effect is increased when a video presentation utilizes actors where speech and gestures are associated[13]. Here the enriched content and delivery methodology work in concert to enhance the positive effect. By creating training programs that utilize two camera angles simultaneously and playback to two eyes simultaneously, there is a match with the way vision actually works and perceives, and participants' brains know the difference. Recent work by Changizi suggests an additional function for binocular vision. He observes that it is a means to discern things within cluttered visual fields[14]. This provides a clear advantage in recognizing potential hazards.

In order to optimize video content delivery, distractions must be eliminated. Fougnie and Marois showed that distractions that consume working memory can cause visual inattention which they called "inattentional blindness"[15]. This concept was reinforced by the work of Vogel and Fukuda who looked specifically at diversion of attention by distractions in the visual field [16].

Recording Sound the Way People Really Hear

Ear placement allows us to determine the direction and movement of sound. Whereas we are not conscious that our brains are constantly processing two different visual images because they appear to us as one, we learn early on, to understand that we hear something slightly different out of each ear.

Audio is different in another way. While light travels so fast that the movement cannot be perceived, sound waves are slow enough to perceive movement. Auditory velocity creates perception of movement[17]. Sound waves are pressure waves caused by some disturbance in an "elastic medium", such as the air in a room, and can generally be felt as well as heard. Therefore, sound is not an exclusive sense, in that it may incorporate the sense of touch as well as hearing. To record sound in a way that matches the way that people hear requires binaural microphones. Bona fide binaural sound playback in a closed environment requires control of the audio input to each ear. This is best achieved with closed-air earphones, to eliminate unwanted environmental noise. Auditory distractions affect short-term memory therefore are detrimental to the learning process [18].

The combination of recording visual and auditory content in the ways that the human brain best perceives and pays attention, combined with the elimination of potential distractions, sets the stage for achieving new levels of training impact.

Reviewing Key Program Elements

In order to cause a response in the brain, desired level of memory, and subsequent behavior, it is highly beneficial that training content be delivered in a way that participants perceive as real.

Simple "do this, don't do that" instructions tend not to reflect the actual complexity of decision making and behaviors. It is important that individuals understand proper procedures, but is not a comprehensive approach. Expectation and achievement of proactive and prudent safety behavior requires that two other conditions are met beyond the memory that allows individuals to "know what to do". First there must be alignment between beliefs and the desired behaviors. Second there must be an underlying sense by an individual that his or her actions do have an impact upon the outcome.

The unique, proprietary 3-D immersive content delivery targets all of the key program elements. Because it targets not just superficial behavior, but the complementary patterns of behavior and beliefs, results could be expected to be profound and durable.

The following tables provide data support for program results, in two different types of settings: industrial; and warehousing & logistics. In both cases, the organizations involved had a long and conscientious track record of commitment to safety. Both organizations also had achieved a degree of success in managing workplace injuries, but could not improve beyond that point. Lost time injuries prior to the 3-D immersive intervention remained a major source of cost, lost productivity, lower quality, and a higher risk profile for underwriting purposes.

The graphs illustrate the substantial improvement following the 3-D immersive programs. The benefit to the organizations manifested in two ways:

1. The immediate reduction in injuries, with all their attendant direct and indirect costs
2. The long-term effect that reflects the internalized change in program participants and the favorable group dynamics in the work environment that resulted from the program. From an economic standpoint, this effect extends the benefit not only in reduced injuries, but also in reduced re-training time and investment

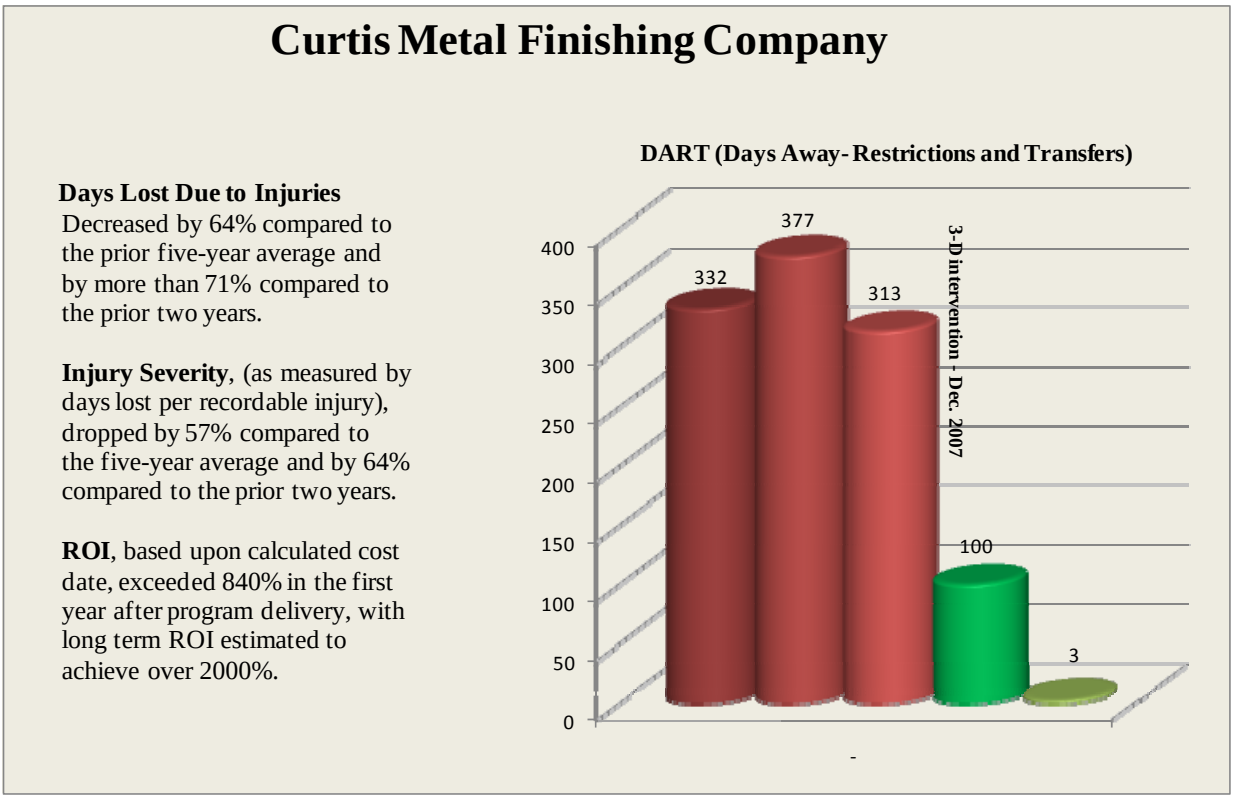

Figure 2. Days Away—Restrictions and Transfers

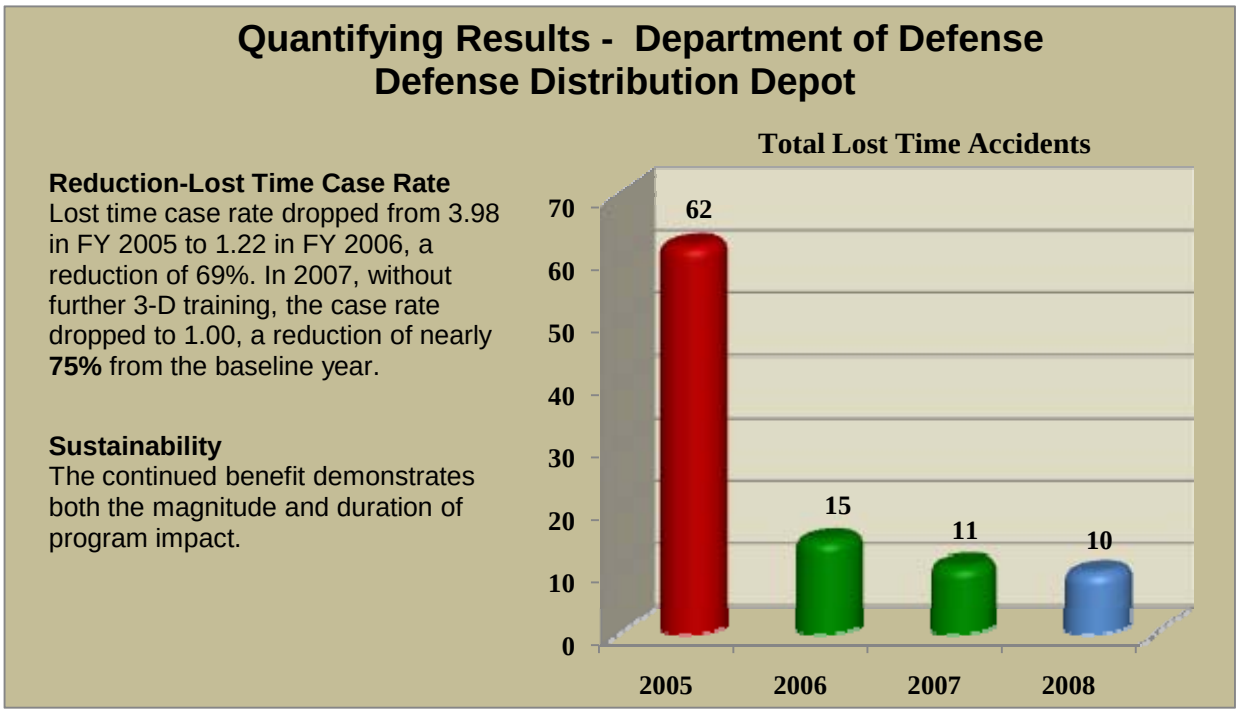

Figure 3. Quantifying Results: Department of Defense Distribution Depot Total Lost Time Accidents

Summarizing the Opportunity

Conscientious organizations have long understood the payback earned from an investment in effective safety training. Those organizations that maintain a commitment to safety over time generally achieve a significant return on that investment. However, the limitations in content delivery have not allowed programs to optimize the way in which program participants change as a result of the program.

Because of this limitation, training programs require additional length initially which requires a greater investment of time, and its associated cost. Because of the shorter duration of positive effect, there is a need for more frequent re-training, as to the time and out-of-pocket investment.

The confluence of emerging technology delivery systems, established psychological theory, and increasing understanding of how activity in the brain relates to memory and behavior, has created a new and unique opportunity to deal with a persistent costly problem. Because program impact includes a significant element of how participants think about themselves, it is normal to expect carryover of principles to other parts of participants' lives. This has been documented in follow up interviews with program participants, and has implications in terms of other key organizational objectives, including quality, service, off-the-job safety, and employee health.

As with many technology-based content delivery systems, such as the Internet itself, early adoption generally exists in the laboratory, test sites, and test groups within larger clients. As technology cost goes down and reliability goes up, the technology becomes adopted on a wide scale. The proprietary 3-D immersive system discussed here has undergone over 120,000 hours of development, and has delivered programs to over 20,000 participants. It has established a new

state-of-the-art method of in program delivery and provides a unique strategic and operational option for organizations seeking to improve performance at the group and individual level.

The preceding is intended to provide information to leaders in organizations of all types. It is not intended as legal, medical, or professional advice, and should not be utilized as such. Organizations seeking such advice should contact credible professionals in those respective fields.

Appendix: Harnessing Cognitive Psychological Theory for Durable Behavior Change

Habituation: Anyone who has had allergy shots is familiar with the phenomenon of habituation, more commonly known as *desensitization*. People with allergies have too much response to something in their environment, such as ragweed pollen. During a program of desensitization, they are exposed over and over again to increasing amounts of that allergen, until they no longer have such a troublesome response.

In the PTSD example described earlier, a similar process is used. Repetitive exposure to a triggering stimulus ultimately reduces the magnitude of the response. This allows the patient to live a more normal life.

For an allergen, there typically is a high degree of specificity in what triggers the response. In psychological responses, there may also be *stimulus generalization*, where a response is due to a trigger other than the original one. This happens when the individual in some way interprets it as the same or similar. That is one reason that seemingly normal events or things in the environment can cause such a significant response. For a person with PTSD, a ringing doorbell or a honking car horn can cause a very significant response. It can be helpful to people in this situation to desensitize, so their response is not so strong, and also to differentiate, so they only respond to something that may be an actual hazard.

Allergists utilize real allergens in order to create the necessary response. In desensitization for psychological situations, it is the simulated reality of the situation that causes the behavior change. By harnessing all the senses and all the emotional content of real events, the behavior change is achieved. It would not be achieved by the same amount of exposure to a written or oral description, nor by two-dimensional pictures nor video presentations.

Habituation is critically important as otherwise individuals would try to pay attention to all of the thousands of different things going on in their environments. It would be impossible to focus, accomplish tasks, and have appropriate reactions. But habituation isn't always a good thing.

Where does habituation fit into safety training? Is the typical problem that employees pay *too much* attention to things in their environment, *overreact* to potential hazards, and stay *too vigilant*? Obviously, for safety training, the issue is the opposite. The reason will be clear if you look at the sequence of events. The trauma came first with Hurricane Katrina, September 11, 2001, and war. The heightened awareness came second. In a typical safety training situation, the traumatic event has not yet occurred. It merely is a potential event that is to be prevented. It does not yet seem real to program participants, who may in fact not have enough vigilance, don't

acknowledge the potentially serious consequences, and don't take enough steps to prevent injuries. The training challenge is to make the potential consequences of poor safety choices become real.

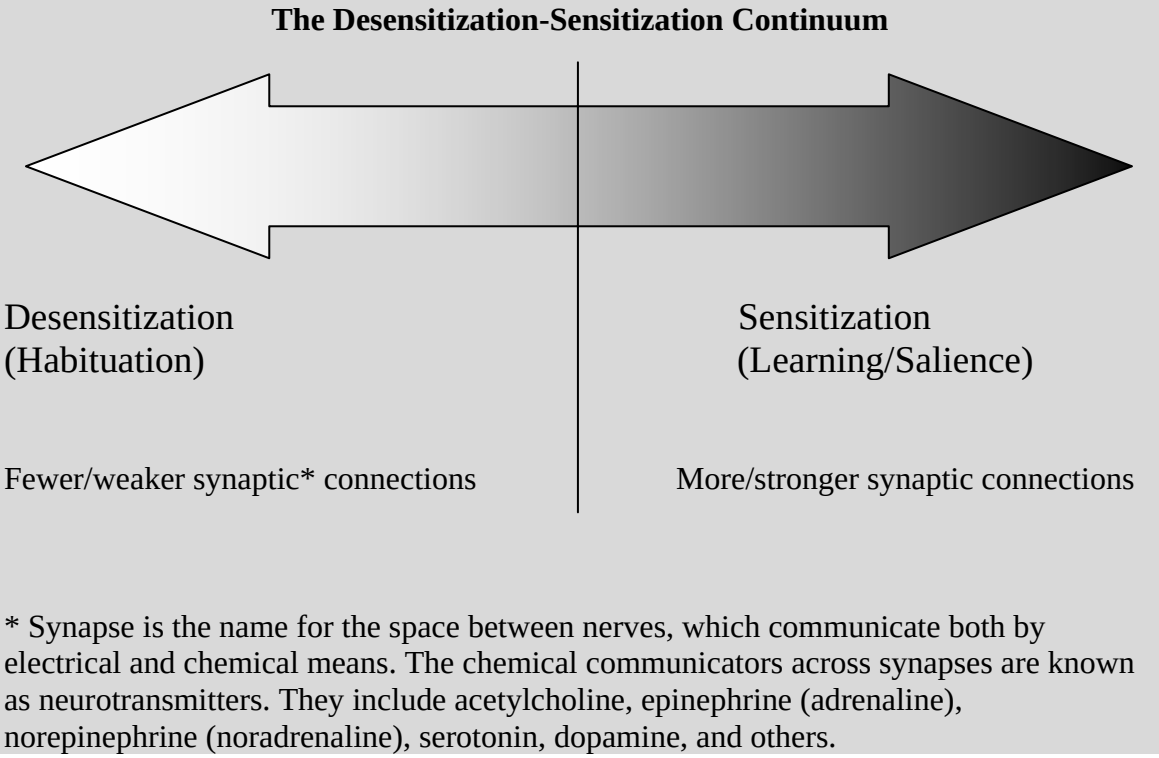

Figure 4. The Desensitization-Sensitization Continuum

Through the work of Nobel Laureate Eric Kandel(et al.)[19] it is known that in habituation situations, not only does behavior change, but the underlying network within the brain, *neurons* and *synapses*, will actually change as well. Both the number of neurons involved in a response and the connections between neurons decrease.

Conversely, when sensitization or learning occurs, the number of neurons involved and their connections increase. This can be confirmed with fMRI studies. For everything that we might consider a behavior, a memory, or a perception, there is a corresponding event or change in the brain itself.

It is worth looking at some findings on areas of the brain that already are known to tie into complex behavior patterns. There has been much discussion on the concept of *empathy*, a human feeling, as to its role in evolutionary development, and as to a potential genetic basis. Through the work of Hutchison[20], we know something about empathy and an area of the brain known as the *anterior cingulate cortex*. Test subjects were divided into two groups, with each group wired to track brain activity. In the first group, individuals were stuck in the arm with a pin. Aside from the expected reaction, there was brain activity in the anterior cingulate cortex. A second group was not stuck with a pin, but observed a realistic portrayal of someone else being stuck with a pin. The remarkable finding is that this group as well showed the same type of brain activity in the anterior cingulate cortex. So, the human feeling we call empathy has a clear and specific concurrent brain process. The key again is that the modeling be as close to real as

feasible. This suggests the power of modeling in evoking the same type of feelings and response as if something were happening to the participant himself or herself.

Other human emotions affect how we learn as well as what future behavior will be. For example, the feeling of regret also has a corresponding brain activity. The orbitofrontal cortex, which is involved in both reasoning and emotion, responds to regret. This enhances learning and evaluation of potential outcomes (Miller)[21]. Assessment of potential risk from a future event is critical in developing prudent safety practices. There are many different areas in the brain involved in every aspect of human behavior.

Sensory Input and Cognitive Factors: In any of the literature covering areas of the brain, learning, and memory, the hippocampus continually appears as a key bridge between current experience and long-term memory (LTM). This was established at least as early as 1957 by Milner[22] in the era before confirmation by fMRI was possible. Current research confirms the key role. Henneman established that hippocampus shrinkage is the best predictor of onset and severity of Alzheimer's Disease[23].

Memory however is not the only factor in predicting whether people will apply learning to a situation. Certainly absent memory or what to do, the results will not be optimal, so memory is absolutely critical. All technologies and approaches to ensure memory should be utilized. There is the phenomenon beyond breakdown in behavior caused by lack of memory or memory failure. This is the situation where people have learned and do remember sufficiently to take the optimal action, but do not.

William James, father of American psychology, made the critical distinction: *Memory* is a conscious awareness of the past; *Habit* is unconscious, mechanical, reflexive action[24]. From this distinction it can be seen that memory is critical, but alone does not guarantee performance. A comprehensive behavior change approach must affect additional aspects of individual behavior.

Aligning behavior and beliefs: Starting in the 1950's, compelling studies challenged the notion that people always begin with beliefs and that their behavior follows from those beliefs. Everyone knows from personal experience that this is not a firm rule. People behave in ways that appear irrational to others. Sometimes, in retrospect, they will recognize that the behavior was in fact irrational as judged against their own beliefs and standards, and sometimes they will explain the apparent mismatch – "I didn't wear safety glasses because it was hot and the sweat would have dripped into my eyes" or "I didn't buckle my seatbelt because I was just going around the corner and I didn't want to wrinkle my clothes" or "no one should start a diet on a Friday. I'll start fresh on Monday." There is even a specific word to describe the way that people explain some behavior or choice as rational, when against even their own standards it is irrational – the word is *rationalize.*

The act of rationalizing is another way of explaining behavior or figuring out why someone did something. That someone may be the individual himself or herself. Through the work of Heider et al., the principle of *attribution*[25] developed. In the attempt to explain why things happen, people try to determine causes. Sometimes, the cause is perceived as external, or beyond the control of the individuals involved. Other times, the attribution is that those individuals were responsible for the outcome.

For example, if you plan a picnic for two weeks from now, and it rains that day, neither you nor those around you would attribute the rain to your actions. They would attribute it to the random aspects of nature. However, if you make chicken salad the night before, failed to

refrigerate it, and everyone gets food poisoning, you would be held responsible. The argument that nature put the bacteria there and all you did was provide a medium on which they could replicate, would not be credible.

Similarly, if you learned that someone was donating a kidney to a stranger, you might well think that the individual is caring, altruistic, and selfless. If you subsequently learned that a wealthy recluse offered $10,000,000 to a suitable donor and the operation was conducted offshore on an island with no extradition treaties, because it would not have been approved by a medical ethics board, you might realize that the donor was motivated by money. Figuring out what people and even you yourself believe can change radically, based upon how they attribute the cause of behavior that you observe.

Cognitive dissonance and self-perception: The work of Festinger and Carlsmith[26], later amplified and expanded by Bem[27], also focused on the theme that interpretation of the cause of behavior and the cause of outcomes influenced beliefs. The original 1957 experiment that led to coining the phrase *cognitive dissonance* is key to understanding the impact of extrinsic versus intrinsic rewards. Two experimental groups participated in the same monotonous experiment. One group received a small monetary payment, the other a significantly larger monetary payment. Days after the participants left the laboratory setting and went back to their lives as undergraduate students, they were asked how much they liked participating in the experiment.

Before continuing with the response, it is important to make a predication. Most people at first predict that those who received the significant extrinsic reward (a fair amount of money, especially for an undergraduate student in 1957) would report liking the experiment better. After all they could *associate* the meaningful reward with their behavior, and therefore think positively of the experience. In fact, as predicted by operant conditioning theory, they might well elect to repeat the experiment if they had the opportunity to do so.

In fact, actual response was exactly the opposite. The students who were paid an insignificant amount of money, reported enjoying the experiment more. Upon further examination, the logic becomes clearer. Students who received a significant amount of money "knew" why they participated in a monotonous experiment – it <u>was</u> the money.

Students who received the modest amount of money couldn't use that explanation. They needed a different answer. To the extent that they experienced cognitive dissonance, a mismatch between their behavior and the way they think of themselves, and needed to resolve that dissonance, a different answer was required. The fact that they tolerated the experiment could not be changed; the amount of money they received could not be changed; the only factor available for them to change was their perception of how they enjoyed the experiment. Everything would make sense again, and erase the dissonance, if they came to the conclusion, that in fact they really did like the act of participating in the experiment. A belief and attitude changed in order to reconcile what happened.

Modeling and self-efficacy: The work of Bandura[28] established the power of modeling to evoke positive or negative behavior change. In a classroom situation, neutral behavior by young children shifted to aggressive behavior once modeled by an authority figure (e.g. teacher). Conversely, modeling calm behavior in response to a fear-inducing stimulus (e.g. snakes for people who have snake phobias), assisted them in their desensitization process. Additionally, the behavior changes in both of these situations happened quickly and lasted for a long time. The length of interventional behavior therefore is not necessarily the critical factor. However, the effect on belief systems and peoples' perceptions of what they are able to do can create

significant, lasting change. Self-efficacy speaks both to peoples' beliefs in what they can do and will do. Once established it has resilience.

Locus of control and safety: The work of Rotter[29], established this principle: an *internal locus of control* suggests that for a given situation, an individual thinks that his or her actions are the main determining factor in the outcome; an *external locus of control* suggests the opposite, which is the perception that outcomes are beyond the control of the individual, and are due instead to other people, random chance, nature, or some other external factor. For an individual, locus of control varies from situation to situation. When actions are perceived to have no impact on outcomes, no action is taken. At a tragic extreme, this leads to a phenomenon called *learned helplessness*[30], where no action is taken, even if it would in fact have had an effect.

In the workplace, external locus of control is counterproductive and inhibits proactivity. A feeling of futility or irrelevance is demotivating. Internal locus of control has the opposite effect. It creates not just a sense of empowerment, but one of responsibility, because action or inaction has consequences. Locus of control has been studied in a variety of circumstances. Across situations such as safety (Jones, Wuebker)[,31] sports injuries (Dalhauser, Williams, et al), [32, 33] and health behavior (Stuart, et al.),[34] demonstrate the importance of locus of control in terms of successful behaviors and outcomes.

Retrospective and prospective views of behavior and outcomes: The cognitive psychological theories just discussed have two things in common: they all relate to the relationship between beliefs and behavior; and they acknowledge the complexity of decisions and tasks. The *temporal gap* between the behavior and the belief can exist in either direction. In some instances, a behavior or event occurs in the past and an individual later comes to a conclusion about the cause or underlying belief. In this case, the evaluation is *retrospective* and involves reflection upon things that already have happened. In other cases, the process is *prospective*. It deals with something that has not yet happened and involves a prediction. Factors such as self-efficacy and internal locus of control influence an individual's prediction about his or her potential effect on a future outcome and the probability of achieving a desired outcome. This in turn contributes to greater likelihood of taking action. It is this type of recognition of a need followed by the appropriate constructive action that is the goal of almost all training programs.

Endnotes

[1] Trillium Foundation March 2009; Ontario CA. Note: While governmental and not-for-profit organizations do not utilize the terminology "Profit" and "Loss" in the same way as the commercial sector, response to economic crisis follows the same path of optimizing operational performance.
[2] Leigh; Center for Healthcare Policy and Research, Department of Public Health, University of California, Davis; Seminar for Western Center for Agriculture Health and Safety, November 2008.
[3] U.S. Centers for Disease Control, April 18, 2006 press release.
[4] B.F. Skinner lectures, articles, texts. Note: In modern writings, the phrase "instrumental conditioning" has been used interchangeably with operant conditioning. While they both connote the same principle of reinforcement following voluntary behavior, and both are distinguished from Pavlovian classical conditioning based upon stimulus and response, it is not clear that Skinner utilized the "instrumental conditioning" terminology. The historical roots of that concept appear to pre-date Skinner and emanate from the work of Thorndike (1874-1949) and follow from his "Law of Effect".
[*5] Filak V. and Pritchard, B. Fulfilling psychological vs. Financial Needs. From paper presented at Association for Education in Journalism annual meeting 2008. And: Panagopoulos, C. Turning Out, Cashing In: Extrinsic Rewards, Intrinsic Motivation and Voting, presented at Midwest Political Science Association National Conference 2009.

[6] McCarney et al. The Hawthorne Effect: A Randomised, Controlled Trial; BMC Medical Research Methodology 2007 7:30. Additional references. Note: The often cited and often misunderstood Hawthorne Effect was named for productivity studies during the late 1920's and early 1930s at a Western Electric facility in the Hawthorne section of the Cicero suburb of Chicago. Changes in workplace environment were followed by periods of increased productivity, which then diminished over time. Additional changes followed the same pattern of a temporary rise in productivity followed by a return to baseline. Two hypotheses are found commonly in the literature of the decades that followed: a) the environmental changes were interpreted by employees as a sign that management valued their contribution; b) the fact that employees were being observed and measured became known even when it was supposed to be unobtrusive. This distortion is well known in physical systems as the *Heisenberg Uncertainty Principle*, in which the observer, or observation itself, affects the measurement. Both hypotheses would predict the outcome of short-lived improvements in productivity. As no underlying attitudes or beliefs amongst employees were addressed, behavior returned to baseline. In modern day organizations, these lessons learned have increased the focus on training that does not merely change environmental or extrinsic reward structures, but changes the way that employees perceive, think, and evaluate the impact of their own behaviors.

[7] Arno Penzias; lectures 1990 hosted Yale University. Note: This Nobel-Laureate made the important distinction between the great efficiencies of micro computing, and the ubiquitous behavior and societal change that would be caused by the Internet. This type of distinction has continues to repeat itself when technological capabilities at first show great theoretical promise, followed by the profound effect of widespread adoption. The technological advance predicts, but precedes the paradigm shift.

[8] Gordon Moore; Intel Corporation. Note: In 1965 Gordon Moore made the stunning, and accurate, prediction that the number of transistors on a chip would double every two years. Applied in a more general way, this has predicted the explosion of technology developments of increased utility at the individual level, greater ease of use, and lower cost, which are seen in the ubiquitous adoption of information technology and content delivery at the consumer and employee level.

[9] Edgar Dale: lectures, writings Ohio State University. And Raymond C. Wiman, Wesley C. Meierhenny; Educational Media: Theory into Practice, Columbus: Merrill. Note: The knowledge that direct experience has advantages over purely intellectual instruction has been discovered through anthropological study and captured in historical records throughout history. Edgar Dale recognized the impact that emerging technologies were having on the rapidly evolving entertainment industry, and applied those principles to the field of instruction. In the original "Cone of Learning" or "Cone of Experience," Dale created an instructional hierarchy reflecting his and others' observations about the progression from intellectual, abstract learning, to increasingly enriched and experiential learning. Later work by Wiman and Meierhenny and others helped to quantify individual retention by participants in instructional experiences.

[10] New York Times, August 28, 2007 Not A Game: Simulation to Lessen War Trauma. Additional references.

[11] Roozendaal et al. Glucocorticoid Effects on memory Retrieval Require Concurrent Noradrenergic Activity in the Hippocampus and Basolateral Amygdala; Journal of Neuroscience September 2004, 8161-8169. Additional references.

[12] N.M. van Strien et al. Activation of the Human Medial Temporal lobes by stereoscopic depth cues; Journal Neuroimage 2008.

[13] Straube et al. Memory Effects of Speech and Gesture Binding: Cortical and Hippocampal Activation in Relation to Subsequent Memory Performance; Journal of Cognitive Neuroscience, April 2009, 821-836

[14] Changizi; Uncovering the Human Superpowers, Rennselaer Magazine, March 2009

[15] Fougnie, Marois; Vanderbilt University; "Executive Working Memory Load Induces Inattentional Blindness"; Psychonomic Bulletin & Review 2007

[16] Vogel, Fukuda; University of Oregon; "Human Variation in Overriding Attention Capture"; Journal of Neuroscience, July 2009

17 Grantham et al. Role of Dynamic Cues in Monaural and Binaural Signal Detection; Journal Acoustics Society of America 1977, 542-551

[18] Banbury, Tremblay, Macken, Jones; School of Psychology, Cardiff University, Wales, UK; "Auditory Distraction and Short-term Memory: Phenomena and Practical Implications"; Human Factors 2001; Foerde, Knowlton, Poldrak; Department of Psychology, University of California, Los Angeles; "Modulation of Competing Memory Systems by Distraction"; Proceedings of the National Academy of Sciences 2006

[19] Eric Kandel; In Search of Memory: The Emergence of the New Science of Mind, W.W. Norton 2006.
[20] Hutchison et al., Human Anterior Cingulate Cortex Neurons Encode Cognitive and Emotional Demands, Journal of Neuroscience September 2005, 8402-8406; and: Pain-related Neurons in the Human Cingulate Cortex, Nature Neuroscience (2), 1999, 403-405. Additional references.
[21] Michael Craig Miller, M.D.; "Go Ahead, Have Regrets"; Harvard Business Review, April 2009. Note: The series of references that deal with human perceptions or emotional states such as regret or empathy illustrate the dual nature of subjective state and specific brain activity. fMRI has verified that specific activity as predicted functionally, if not specifically, by the early cognitive psychologists.
[22] Milner et al. Loss of Recent Memory After Bilateral Hippocampal Lesions 1957; Neuropsychiatry & Clinical Neuroscience 2000 Winter, 103-113
[23] Henneman et al. Hippocampal Atrophy Rates in Alzheimer Disease; Neurology 2009, 72, 999-1007.
[24] William James; The Principles of Psychology, 1890, Henry Holt. Note: This seminal work took twelve years for James to complete. It still is a foundational reference for psychology and human behavior, and often is quoted in discussions about the concept of *habit.*
[25] Fritz Heider; The Psychology of Interpersonal Relations 1958, Wiley.
[26] J. Merrill Carlsmith; Lectures, Stanford University 1976.
[27] Daryl J. Bem; Lectures 1975 Stanford University.
[28] Albert Bandura; Self Efficacy: Toward a Unifying Theory of Behavior Change; Psychological Review Vol 84, March 1977, 191-215. Additional references.
[29] J. B. Rotter; "Generalized Expectancies of Internal Versus External Control of Reinforcements" Psychological Monograph 80. Additional references.
[30] M. Seligman; Learned Helplessness; Annual Review of Medicine 23, 1972, 407-412. Additional references.
[31] Wuebker (with J. W. Jones Safety Locus of Control Scale); Safety Locus of Control as a Predictor of Industrial Accidents and Injuries; Journal of Business and Psychology, Volume 1, No. 1, Fall 1986.
[32] Dalhauser et al. Visual Disembedding and Locus of Control as Variables Associated with High School Football Injuries; Journal of Perceptual Motor Skill 1979, 49:354.
[33] Jean M. Williams; Stress, Coping Resources, and Injury Risk; International Journal of Stress Management, Vol. 3, No. 4, 1996.
[34] Stuart et al. Self-Efficacy, health locus of control, and smoking cessation; Addictive Behaviors, 1994, Vol 1, No. 19 Elsevier.