Confidential, Google Internal Only

Algorithmic Discrimination from an Environmental Psychology Perspective: Stress-Inducing Differential Treatment

go/discrimination-and-stress

AUTHORS
Sally Augustin (Environmental Psychology Consultant)
Allison Woodruff (Security & Privacy UX)

SPONSORS
Lawrence You (Director of Privacy)
Sunny Consolvo (Security & Privacy UX)

LAST UPDATED
September 2016

Table of Contents

Executive Summary
Overview
How People Respond to Situations
Experiencing Stress
Case Study: Crowding, Physical Stressor
Case Study: Natural Disasters, Physical Stressors
What Sorts of Psychological Stressors Are Most Difficult for People to Tolerate
What Is Control
Benefits of Control and Perceived Control
How to Increase Perceived - Or Actual - Control
Other Ways (Besides Psychological Control) to Counter Stressors
When Control Is Undesirable
Individual Differences and Stressors
Conclusion
Acknowledgments
References

Executive Summary

Based on a review of principles from environmental psychology and related literatures, we suggest the following probable effects of algorithmic discrimination:

1. Discrimination is a stressor, and by implication **algorithmic discrimination is a stressor.**
2. **Stressors have negative cognitive, emotional, and physical consequences, and algorithmic discrimination likely has similar negative effects.** For example, experiencing racial discrimination can potentially damage a person's own opinions about themselves as well as their identification with a larger community.
3. Stressors can impede concentration and problem solving ability, and therefore **algorithmic discrimination is likely to interfere with people's ability to complete online tasks**. For example, it may inhibit completion of tasks that were in progress when algorithmic discrimination was encountered. Someone who perceives that they have experienced algorithmic discrimination while looking for a home refinance loan is likely to be somewhat lackadaisical about moving forward with searching for a home refinance loan.
4. Negative affect can make people's thinking more narrow and concrete, so **people who perceive they are experiencing algorithmic discrimination may think more narrowly, which could influence their purchasing behaviors and response to advertisements or other stimuli**. More restricted thinking is likely to increase the sales of more practical options, at the expense of those that serve higher order needs such as signalling status.
5. Stress has been linked to degraded mood and interactions with others, such as reduced altruism and increased aggression and competitiveness. Similarly, when people are threatened they are more likely to feel uncomfortable, hostile, aggressive, and angry. As a result, **people who experience algorithmic discrimination may be more likely to display negative online behaviors such as aggression or hostility.**

The literature suggests general principles about coping mechanisms and remediations for stress:

1. People's response to stress can take multiple forms, such as **problem-focused coping** (taking logic-based steps to eliminate a stressor, for example, via lobbying the government) or **emotion-focused coping** (modifying one's emotional response or conceptualization of a situation, for example, attempting to re-categorize it in one's mind as less serious).
2. **When people feel they have some control over a stressor--or actually do control it--the negative implications of experiencing that stressor are reduced.** Conversely, lack

of control is associated with increased negative effects such as hostility, depression, and impaired problem solving ability.

3. **Stress tends to be lower when the victim has someone to blame.**
4. **Information can mitigate stress, especially when it comes from a trusted source.** Further, **forewarning people of a potential threat can have an inoculation effect**, reducing the negative effects of an event if it occurs.

Based on these principles, we suggest exploring the following promising directions for remediation of algorithmic discrimination:

1. **Provide external reporting mechanisms**, which could dampen the stressful effects of algorithmic discrimination. Reporting channels are particularly likely to have beneficial effects for stress reduction if they allow people to reach powerful organizations.
2. **Provide information about potential algorithmic discrimination, such as the processes involved, and consider providing advance warning of potential algorithmic discrimination** in certain cases. Information can increase the predictability of stressful situations, which can reduce their negative psychological ramifications.
3. **Provide control mechanisms**, for example provide the ability to restrict what others can learn about them, or to determine the demographic groups to which they are linked.

From a user experience design perspective, consider the following:

1. **Remediation processes** provided immediately after people perceive they have experienced algorithmic discrimination **should be straightforward to execute** (since stressors impede ability to complete tasks, and because 'easy' tasks reinstill a sense of control).
2. **Websites and communications related to algorithmic discrimination should follow standard design principles for stress reduction** (e.g, use few colors, with the colors in use being positioned close to each other on the color wheel; avoid unfamiliar designs).
3. **When designing messaging** related to algorithmic discrimination, **consider that the user may be using either problem-focused coping or emotion-focused coping**. For example, for emotion-focused coping, consider messages that relate to influencing someone's affective response or their appraisal of a situation or themselves, as opposed to directly alleviating the issue at hand.

Note on methodology: To date, only limited research exists on the specific topic of people's psychological responses to algorithmic discrimination. In this report, we integrate salient points from research on related phenomenon in order to suggest likely implications for algorithmic discrimination. Further research could be done to confirm these extrapolations.

Overview

Algorithms can be mysterious and that can lead to confusion and lack of trust, as evidenced by recent public discussion of the news stories posted by Facebook, which were selected, at least in part, via algorithms that scanned the web for information on current events. After a heated public discussion, Facebook revealed article selection algorithms and review processes that seemed to appease critics (see, for example, Isaac, 2016)-- or more accurately, allowed public dialog to move along to topics unrelated to Facebook news postings.

The Facebook news management situation not only drew algorithms and human checks on them to the public's attention, but also highlighted links between organizational values and algorithms used as well as the inevitability of algorithms in modern, web-based life. An August 10, 2015 article in *The New York Times* (Claire Cain Miller, The Upshot Section) has this to say about algorithms and algorithmic discrimination, "Algorithms have become one of the most powerful arbiters in our lives. They make decisions about the news we read, the jobs we get, the people we meet, the schools we attend and the ads we see. Yet there is growing evidence that algorithms and other types of software can discriminate. The people who write them incorporate their biases, and algorithms often learn from human behavior, so they reflect the biases we hold. For instance, research has shown that ad-targeting algorithms have shown ads for high-paying jobs to men but not women, and ads for high-interest loans to people in low-income neighborhoods."

Cynthia Dwork, a computer scientist working at Microsoft Research, discusses the roots and remedies for algorithmic discrimination in the same *New York Times* article quoted in the last paragraph, "Algorithms do not automatically eliminate bias. Suppose a university, with admission and rejection records dating back for decades and faced with growing numbers of applicants, decides to use a machine learning algorithm that, using the historical records, identifies candidates who are more likely to be admitted. Historical biases in the training data will be learned by the algorithm, and past discrimination will lead to future discrimination. . . . Fairness means that similar people are treated similarly. A true understanding of who should be considered similar for a particular classification task requires knowledge of sensitive attributes, and removing those attributes from consideration can introduce unfairness and harm utility."

On June 25, 2016, the discussion of algorithmic discrimination continued in *The New York Times* (Crawford, 2016). Crawford reports on "the very real problems with artificial intelligence today, which may already be exacerbating inequality in the workplace, at home and in our legal and judicial systems. Sexism, racism and other forms of discrimination are being built into the machine-learning algorithms that underlie the technology behind many 'intelligent' systems that shape how we are categorized and advertised to." She cautions that "We need to be vigilant

about how we design and train these machine-learning systems, or we will see ingrained forms of bias built into the artificial intelligence of the future."

Algorithmic discrimination (AD) results when online processing of information leads to unequal service to, or categorization of, individual segments of the population who should be treated in the same manner. These inequalities might be based on race, gender, sexual identity, or some other factor, visible or invisible.

AD is a stressor that impedes situational perceived control when people recognize that the discrimination exists. The psychological discomfort resulting from AD is similar to that which results from being in a physically stressful situation. People respond the same way to physical and psychological stressors that are short and longer term. The remedies for both psychological and physical stress are consistent, with those most relevant to algorithmic discrimination being tied to providing people who have experienced or may experience AD with control over their related experiences and resilience-related training. Arguments and references to support these statements follow.

Annually, the American Psychological Association (APA) surveys Americans to learn about the stressors they experience. In 2016, APA combined their yearly general survey with questions specifically related to the stress of being discriminated against. The researchers identified people who had experienced discrimination by asking participants in their study questions to determine if they had been treated with less courtesy or respect than other people, received poorer service than others at a restaurant or store, been treated as if they were not smart, not been hired for a job for unfair reasons, been unfairly stopped or physically threatened or abused by the police, been unfairly prevented from moving into a neighborhood because someone would not rent or sell to them, or been unfairly treated while using transportation (such as a bus), for example. Anyone who had had any of these experiences was categorized as having been discriminated against.

The APA team reports that "A wealth of psychological research shows that discrimination can exacerbate stress. Moreover, discrimination-related stress is linked to mental health issues, such as anxiety and depression" (p. 6). In addition, "experiencing discrimination is associated with higher reported stress and poorer reported health. . . . dealing with discrimination results in a state of heightened vigilance and changes in behavior, which in itself can trigger stress responses--that is, even the anticipation of discrimination is sufficient to cause people to become stressed" (p. 8). Also, "Despite the stress, the majority of adults who report experiencing discrimination (59

likelihood of inflammation somewhere in our bodies (references provided in text of report, below).

More acute stress can result in a psychological condition known as reactance (a motivation to regain a freedom after it has been lost or threatened) against the situation, or alternatively it can result in resignation to it and life in general, depending on personal factors, such as personality, the context in which an experience takes place, and how important the thwarted goal was to the person stressed's self-identity. For example, if an individual's self-identity includes the fact that they are an accomplished and successful sailor, rejection for a boat loan would be particularly likely to result in reactance.

When people feel their life experiences are being unfairly curtailed, as many people encountering AD must believe, reactance may set in. When people are experiencing reactance they take action to re-establish their ability to control their own destiny, for example, by crusading to change policies so that AD becomes less less likely in the future or taking legal action against those they perceive have discriminated against them.

Continuing, seemingly unavoidable, unchangeable, and apparently uncontrollable stress also regularly leads to the experience of learned helplessness, or a certain debilitated acquiescence to fate, which has been linked to impaired cognitive performance, for example. Learned helplessness can broaden from its original context to others. For example, people might initially feel learned helplessness related to their ability to get the same home loan as people not being discriminated against, and, subsequently, experience the same sort of debilitated acquiescence related to their ability to maintain a healthy weight.

To counter these negative effects of AD-related stress, control, or at least perceptions of it, as mentioned above, can be very useful. Active engagement and/or the potential for redress provide control, for example, in an AD context. With both physical and psychological stressors, negative reactions are diminished when perceived control over them exists. Control isn't for everyone all of the time, however, as described below, but is generally desirable.

This report discusses both physical and psychological stress because review of physical stressors can shed important light on stressors without a concrete component. Evans and Cohen's work supports this approach (1987). Li and Li have also indicated important links between physical and cognitive experiences, specifically feelings of privacy (2007). In their work they effectively "operationalize[d] the measure of information privacy by using interpersonal distance as a unit of measurement" (2007, p. 317).

Gianaros and Wager also report a tie between physical and psychological stress: “Psychological stress is thought to arise from appraisal processes that ascribe threat-related meaning to experiences that tax or exceed our coping ability. Neuroimaging research indicates that these appraisal processes originate in brain systems that also control physiological stress reactions in the body. Separate lines of research in health psychology and behavioral medicine indicate that these physiological stress reactions confer risk for physical disease. . . . .Emerging neuroimaging evidence has begun to map the brain systems that generate states of psychological stress and to link these states with visceromotor (feedforward) and viscerosensory (feedback) mechanisms important for health” (2015, p. 313, p. 320).

In this review, the first topics addressed are stress and control, real and perceived, and their influence on attitudes and behaviors. Next, the discussion turns to opportunities to redress negative situations resulting from stress and individual differences that influence stress experiences.

How People Respond to Situations

Dean Simonton has integrated insights he has gathered over many years as a well-respected research psychologist to develop a comprehensive system of 8 everyday human responses to situations (in press). His quantitatively and empirically based system distinguishes between responses using initial probability, actual utility, and the responder’s prior knowledge of that utility.

Simonton carefully defines each of these factors. Initial probability (p) can range from 0 to 1 with a value of 1 indicating that a response is automatic and 0 that a certain response is unavailable at a particular moment but may ensue after an incubation period. Actual utility (u) can also range from 0 to 1 with 1 indicating a response is “maximally useful . . . satisfying every single utility criteria” and 0 indicating that it is absolutely useless (page numbers are unavailable since the article is in press). An individual’s prior knowledge of the actual utility for the resulting thought or behavior (v) similarly ranges from 0 to 1, with a value of 1 meaning that the actual utility is clearly known when a response is conceived and a score of 0 meaning the utility is completely unknown in advance. A pure guess for the solution to an arithmetic question would have a v score of 0.

Simonton’s set of situational responses are: “(a) routine, reproductive, or habitual responses (based on acquired life and work expertise); (b) fortuitous responses (such as uninformed response biases); (c) irrational perseveration (or failing to learn from past mistakes); (d) problem finding (such as violations of expert expectations); (e) irrational suppression (refusing to do what’s good for you); (f) creative or productive thoughts and

desirable because of AD. Decision heuristics can influence the evaluation of situations and their ultimate categorizations as stressors or not-stressors.

Decision heuristics especially important with AD-related assessments are noted here; each is discussed in Kahneman (2011). Each of these heuristics can distort more objective assessments of conditions/situations, and influence whether AD is perceived and its negative repercussions ensue:

- Availability heuristic - the fact that information that is easy to access cognitively can have a significant effect on opinions formed
- Endowment effect - evaluating something as more valuable just because it is currently owned
- Status quo bias - a preference for continuing the current circumstances/state of affairs
- Confirmation bias - greater ease in attending to and accessing information in our memory that aligns with our viewpoints and values than that which doesn't
- Optimism bias - the belief that something negative is more likely to happen to someone else than us

Once a situation is categorized as stressful, there are inevitable psychological and physiological implications of that assessment.

Physical stressors, for example, lead to both psychological and physiological responses which in turn prompt psychological coping behavior (Evans and Cohen, 1987). Evans and Cohen describe stressful situations as Kim and Diamond (2002) do (as noted in this document's overview) "we are not claiming that stress is inevitably or even predominantly a function of variation in environmental quality. Stress is inevitably a person-based concept. . . . Environmental stressors are typically aversive, primarily uncontrollable, and of variable duration and periodicity. . . . stress occurs when one decides that environmental stimuli are likely to tax or exceed one's personal coping capacities" (Evans and Cohen, pp. 571, 572, 573). Evans and Cohen do report that some stressors are extreme enough so that all who experience them perceive them as such; these "no contest" stressors might include a wildfire or an extremely shrill or loud noise. A physical experience is, however, categorized as stressful or not based on the motivation context of an individual (Apter, 2007). For example, loud-ish music may be stressful when people are attempting to study in their dorm but when they are done studying and are attending a concert or party.

Once we assess a situation and determine that it is stressful, that "stress is a biologically significant factor that, by altering brain cell properties, can disturb cognitive processes such as learning and memory, and consequently limit the quality of human life. . . .Stress . . . is generally defined in

noted above for stress in general still ensue, including lower motivation and greater difficulty overcoming infectious diseases.

Overgeneralization results when "a strategy that has been adopted to cope with a stressor becomes a characteristic operating mode for the individual even when the stressor is no longer present" (Evans and Cohen, 1987, p. 580).

Warning people about potential physical stressors, such as crowding, results in less stress experienced and less degradation of task performance (Evans and Cohen, 1987). Anticipating stressful physical situations, for example, crowding or noise "causes reactive symptoms strikingly similar to actual exposure to stressors" (Evans and Cohen, 1987, p. 598). After people learn that AD exists, similar anticipatory effects likely result.

Researchers from the Max Planck Institute for Cognitive and Brain Sciences and the Technische Universität Dresden report that "stress is contagious" (Your Stress is My Stress: Merely Observing Stressful Situations Can Trigger a Physical Stress Response," 2014). They learned that "Observing another person in a stressful situation can be enough to make our own bodies release the stress hormone cortisol. . . . In our stress-ridden society, empathic stress is a phenomenon that should not be ignored." Contagious stress has been linked to "burnout, depression and anxiety."

Coping with AD can be either problem-focused or emotion-focused: "Problem-focused coping strategies involve changes in the situation to reduce aversive impact whereas emotion-focused coping strategies alter individual responses to the negative situation. Either of these coping styles can assume various forms such as information seeking, direct action, or palliative activity" (Evans and Cohen, 1987, p. 577). Both are relevant to remediating AD-related stress. As Evans and Cohen relate, "Another effect of coping with chronic exposure to aversive, uncontrollable stressors may be a shift in coping strategies from problem-focused to emotion-focused coping. Reappraisal of threat may occur, for example, whereupon an aversive condition (e.g., smog) that was initially critically viewed becomes reappraised as a minor problem or threat" (1987, p. 582). People experiencing AD might receive materials to support this sort of transition.

Wei, Ku, Russell, Bonett, and Alvarez, noted the following relationships between strategies for coping with discrimination and personal factors: "Education/Advocacy, Internalization, Drug and Alcohol Use, and Detachment were positively associated with active coping, self-blame, substance use, and behavioral disengagement, respectively" (2010, p. 328). A fifth coping strategy, resistance, was not linked to active coping, self-blame, substance use, or behavioral disengagement. Wei and his team describe resistance as "Resistance indicates challenging or confronting individuals for their discriminatory behavior" (p. 332). In some ways, racial

discrimination is different from other stressors, according to Wei and team because “Unlike other

Humans have developed protective mechanisms to counteract the negative implications of crowding. People who have been on a crowded elevator have seen some of these activities firsthand. For example, as Argyle and Dean (1965) discuss, people feeling crowded are likely to avoid making eye contact with each other. This sort of denial of access via shielding, to some extent, of the eyes, is consistent with associations between feeling crowded and insufficient privacy or control over access to the self.

When people feel crowded, social withdrawal is likely. This can also result in "less eye contact, greater interpersonal distancing, and less initiation of conversation" (Evans and Cohen, 1987 p. 590). Baum and Paulus report that people act socially withdrawn even after they leave the crowded situation and can respond aggressively when they feel crowded (1987).

In addition, the negative effects of anticipating being crowded are similar to those that actually result from crowding (Baum and Paulus, 1987).

Being crowded has further consequences. Maeng (2014), via research conducted in a retail context found that a "socially crowded environment leads people to think more concretely . . . . and lowers willingness to pay for a product. . . . socially crowded environments tend to lead consumers to . . . categorize objects more narrowly, and favor products with feasible features." This concrete, narrowed thinking is typical of individuals in a negative mood (Isen, Johnson, Mertz, and Robinson, 1985). Similarly, people experiencing AD might be expected to think more narrowly after it is noted, which could influence response to advertisements or other stimuli. More restricted thinking is likely to increase the sales of more practical options, at the expense of those that serve higher order needs, by signalling relatively higher status, for example.

Andrews and her colleagues studied the behaviors of people on subway cars that were assessed as more or less likely to feel crowded based on the number of people present (2015). The team worked with data "from one of the world's largest telecom providers who can gauge physical crowdedness in real-time in terms of the number of active mobile users in subway trains." They report that "The telecom provider randomly sent targeted mobile ads to individual users. . . . Based on a sample of 14,972 mobile phone users, the results suggest that, counterintuitively, commuters in crowded subway trains are about twice as likely to respond to a mobile offer by making a purchase vis-à-vis those in noncrowded trains." Survey evidence lead Andrews and her team to the conclusion that "As increased crowding invades one's physical space, people adaptively turn inwards and become more susceptible to mobile ads. . . . Mobile ads can be a welcome relief in a crowded subway environment" (p. 218). This response indicates that people experiencing AD-related stress will seek relief from that stress via online or offline stimuli,

particularly if direct steps to remedy the AD are not present. In a crowded train car an analogous direct remediation is to leave the crowded car.

Modifying contextual factors make it more or less likely that people will feel crowded. For example, people with close positive relationships are likely to feel less crowded in a situation than people who are meeting for the first time in the same space (Gifford, 2014). Consider, for example, the experience of sharing a stateroom on a cruise ship with family members or the same number of strangers.

Meagher and Marsh report that spaces that are actually the same size can seem different sizes depending on how furnishings in the rooms are arranged (2015). When furnishings are positioned in a way that supports the probable/desired activities in a space (e.g., completing assigned tasks in workplaces), a place seems larger than when arrangements aren't supportive. A space can be high density, containing many pieces of furniture, for example, but not seem crowded if the items in it clearly support desired activities. These findings support the ability of control to counter stress mentioned earlier.

Baum and Paulus report (1987), "The features of a setting that make it look larger or that reduce the apparent number of people present reduce judgments of crowding, and features that make it look smaller or that increase the prominence of other people increase judgments of crowding" (p. 546). So, "Architectural features that reduce exposure to unwanted interactions [with other people] or facilitate attempts at regulation of these interactions have been shown to reduce crowding effects. . . dividing a long-corridor floor into two short corridors reduced the negative effects of long-corridor living" (p. 550). Design elements that make a space seem larger, and that seem to restore opportunities for control, are well documented. For example, walls that are painted lighter colors seem further away than those that are darker colors (Stamps, 2011).

This discussion of crowding repeatedly indicates the ameliorating effects of situational control, which can be employed to combat the negative implications of AD.

Case Study: Natural Disasters, Physical Stressors

Environmental hazards can be more acute, relatively unpredictable events, such as

that they are more likely to deny the importance of an actual disaster warning when it arrives" (2014, p. 395).

Gifford carefully delineates the differences between problem-focused and emotion-focused coping (2014). Problem-focused coping can be categorized as more active, with people looking to ameliorate stress in this way taking steps to eliminate a stress, via lobbying the government, for example, while emotion-focused coping is tied to modifying their emotional response to a setting, by for example, attempting to re-categorize it in their minds as less serious.

Immediate responses to natural disasters often involve problem-focused coping, or dealing with rectifying the immediate aftermath of a negative event; as time goes on people focus on getting needed information and taking protective steps and emotion-focused coping may take place (Lindell, 2012). They are complex: "The situational context in which a person responds to a threatening event has physical, technological, social, economic, political, and temporal components" (Lindell, 2012, p. 392). It is important to bear in mind that "When the problem is very difficult to change, a problem-focused approach may actually increase one's distress because one is trying to solve an insoluble problem" (Gifford, 2014, pp. 406-407). In addition, "social support helps disaster victims, but it does not help everyone" (Gifford, 2014, p. 407).

Disasters can spawn community wide efforts to improve wellbeing. As Gifford shares, "One surprisingly frequent and positive immediate post-disaster phenomenon is the therapeutic community, when even unrelated people work together during the disaster or very soon afterward. Therapeutic communities often develop in response to fast-acting natural disasters, but not for slow-moving technological disasters" (Gifford, 2014, p. 402).

Generally, "natural hazards cause more mental health problems [than technological disasters]. . . . the primary psychological difference between natural and technological disasters is the potential for blame: blaming someone for a nuclear plant meltdown is easier than blaming someone for an earthquake. Evidence for non-disaster clinical situations suggests that stress tends to be lower when the victim has someone else to blame, so this may be why stress is greater after natural rather than technological disasters" (Gifford, 2014, p. 406). People who are familiar with how AD often seems to arise (through an innocent mental lapse on the part of an individual or team) may be less likely to hold a specific individual to blame for AD-related discrimination. It is unclear, however, what percent of the general population is aware of the roots of AD-related discrimination. If an individual or team is held responsible for perceived AD-related discrimination, it seems likely that that responsible party would be the product purveyor (e.g., bank, employment firm), because it seems likely that they would be perceived to have provided the biased algorithm. People's response to AD-related discrimination may be

similar to their responses to “creepy” situations, as reviewed in a previous report, when it is difficult to identify responsible parties.

Reviewing the research on the stress that ensues after natural disasters indicates that individual differences can have a significant effect on stress experiences, that social bonds can speed recovery from stress, and also reinforces the relationship between stress-related control and wellbeing.

A study of indoor environmental quality (IEQ) effectively summarizes many of the important issues raised in this section. Lamb and Kwok (2016) report on their longitudinal within-subjects research project, “Characterising inadequate aspects of IEQ as environmental stressors, these stress factors can significantly reduce self-reported work performance and objectively measured cognitive performance by between 2.4% and 5.8% in most situations, and by up to 14.8% in rare cases. Environmental stressors act indirectly on work performance. . . . Exposure to environmental stress appears to erode individuals' resilience, or ability to cope with additional task demands. These results indicate that environmental stress reduces not only the cognitive capacity for work, but the rate of work (i.e. by reducing motivation). Increasing the number of individual stress factors is associated with a near linear reduction in work performance indicating that environmental stress factors are additive. . . . Environmental stressors reduce occupant wellbeing (mood, headaches, and feeling ‘off’) causing indirect reductions in work performance.” (p. 104). Thus, the experience of AD may impede a person’s ability to effectively complete tasks they were in the middle or when they encountered AD, as well as their ability to execute additional or complex tasks, and, as a result, remediation processes provided immediately after people perceive they have experienced AD-related discrimination must be straightforward to execute.

What Sorts of Psychological Stressors Are Most Difficult for People to Tolerate

Researchers have investigated the perceived relative severity of various life stressors. Their work supports efforts to determine which forms of AD have the most significant negative effects on wellbeing. Events that generate the most stress in individuals, those in the 75 points or more category noted below, are likely to produce the most negative results in individuals when they are related to experiences of AD.

Spurgeon, Jackson, and Beach updated research on the Life Events Inventory (LEI) originally conducted by Holmes and Rahe in 1967 (2001). Spurgeon, Jackson, and Beach’s goal was to determine if the original weightings of stress severity, established

- Getting along with partner/family members
- New family member (immediate family)
- Minor trouble with law (conviction)
- Marriage
- Problem with social life
- Problem with neighbors
- Death of pet
- Retirement

Types of AD related to the sources of stress in the list immediately above, for example, relate to delivery of messages about participating in counselling sessions that might help someone get along better with others, for example. If people did not receive information about these sessions because their electronic history indicated an issue with mental illness, which could mean that working with them would be particularly complex and profit margins would therefore be reduced, a mid-intensity AD-related stress would likely ensue. Another example of a moderate AD-related stressor is restricted or no information being provided about a dating or retirement planning site/opportunity because of residential zip code or an apparent psychological condition.

Low stressors, with scores 24 or less are:

- Vacation
- New neighbors
- Income up substantially (25%)

Types of AD related to the sources of stress in the list immediately above, for example, could relate to not receiving notifications of vacation property rentals not distributed to others.

What Is Control

When people feel they have control of a situation they believe that they have some influence on its progress and outcome.

Fiske and Taylor identify six kinds of control (1991):

- *Behavior control*: “the ability to take some step to end an aversive event, make it less likely, reduce its intensity, or alter its timing or duration” (p. 198)
- *Cognitive control*: “the availability of some cognitive strategy that either leads a person to think differently about an aversive event or focuses the person’s attention on non-noxious aspects of the aversive situation” (p. 200)
- *Decision control*: “the ability to make a decision or decisions with respect to a forthcoming stressful event” (p. 201)

- *Information control*: "a sense of control that is achieved when the self obtains or is provided with information about a noxious event" (p. 201)
- *Retrospective control*: changing thoughts related to the causes of a past situation
- *Secondary control*: adjusting some aspect of the self concept, for example, expectations that one could win or perform well. Instead of facing outwards, secondary control ties in to management of the internal psychological state and relates to establishing control via meaning drawn from a situation. This sort of control is accommodative.

Each of these six sorts of control can be employed to minimize the severity of repercussions tied to AD. For example, it might be possible for people to think differently about an AD-related situation (cognitive control) by believing it is actually leading to a positive outcome or process a more complete set of data about the AD which might indicate, for example, details of the discriminating algorithm (information control).

As Mineka and Hendersen state, control, learned helplessness, and reactance are linked, "The effects of exposure to uncontrollable outcomes or failure experiences may be reactance or motivational arousal rather than helplessness or reduced motivation. Unfortunately, the boundary conditions that determine whether reactance or helplessness emerges are unknown" (1985, p. 506).

Learned helplessness can result when people continue to be exposed to environmental--or other--stressors that they cannot control (Evans and Cohen, 1987). When learned helplessness ensues, people devote less energy to overcoming a stressor and to unrelated but desirable activities, such as completing cognitive tasks that may potentially be frustrating. People who experience learned helplessness are thus likely to move forward with their original task with less energy or, perhaps, not at all. So, someone who perceives that they have experienced AD while looking for a home refinance loan is likely to be somewhat lackadaisical about moving forward with searching for a home refinance loan.

Gary Evans and Dana Johnson found that women exposed to stressful simulated office noise (average noise level of 55 dBA, with peaks up to 65 dBA) made fewer attempts to solve unsolvable puzzles than participants not exposed to the noise (quiet conditions, noise levels of 40 dBA); this sort of reduction in effort is generally felt to indicate learned helplessness (2000). Individuals experiencing the simulated office noise were less likely to make ergonomic adjustments to their office furniture. Study participants working in noisier surroundings did not report that they were experiencing more stress than the people working in the quieter conditions. If workers experience learned helplessness they may not take advantage of workplace elements that can enhance their performance, such as acoustically shielded, individual work rooms, according to Evans and Johnson. This study not only provides useful information about the

implications of learned helplessness but also indicates that people may not necessarily able to accurately assess their own stress levels.

The effects of learned helplessness can be countered: “animals and humans that have been exposed to uncontrollable stimulation are given experience with ‘easy’ tasks in order to reinstill a sense of control. Typically, such ‘therapy’ removes the effects of the early pretreatment on subsequent learning of a difficult task” (Mineka and Hendersen, 1985, p. 501). This ability to counter learned helplessness is important because it indicates that for individuals and society as a whole, well designed response tools, ones that make reporting AD and overcoming its negative effects relatively easy, will enhance wellbeing.

Continuing, chronic stressors can also result in increased emotion-focused coping in lieu of problem-focused coping and, potentially specifically in reactance, described below. (Reactance is emotionally based and focused on re-establishing desired levels of control, while problem-focused coping more effectively and efficiently reviews all response options. Reactance is a type of emotion-focused coping, but it is often discussed separately from emotion-focused coping in general, because as a response it has been so extensively researched.)

Steindl, Jones, Sittenthaler, Traut-Mattausch, and Greenberg completed a comprehensive and recent review of research related to reactance (2015). They define it as “the motivation to regain a freedom after it has been lost or threatened” (p. 205). Considering reactance is important because, “In general, people are convinced that they possess certain freedoms to engage in so-called free behaviors. Yet there are times when they cannot, or at least feel that they cannot, do so. . . . Reactance is an unpleasant

activating positive affect, such as feeling strong and determined" (p. 210). Reactance ensues "only if people feel capable of restoring their freedom" (p. 210).

Steps can be taken to reduce reactance "to perceive a message as less threatening, a restoration postscript telling participants that they are free to decide for themselves what is good for them can help . . . . Another method is inoculation, which forewarns people of a potential threat. This strategy reduces the experienced threat and, consequently, reactance effects." (Steindl, Jones, Sittenthaler, Traut-Mattausch, and Greenberg, 2015, p. 210).

Reactance and creepiness have been linked. As Barnard (2015) reports: "Technological progress has enabled marketers to track and use online behavioral data to target consumers more effectively with relevant advertisements than was possible in the past. For example, marketers are increasingly using an online marketing practice called retargeting, in which an individual consumer is served an ad for the exact product she shopped for in the past - at a later time, on a different website. . . . The results [of the study conducted] revealed that while behaviorally targeted online ads do have a positive direct effect on purchase intention, as marketers assume, exposure to behavioral tailoring also sets off a negative indirect effect on purchase intention that attenuates the positive direct effect. This reduction of purchase intention can be attributed to the creepiness factor - or the sense that marketers are watching, tracking, following, assessing, and capitalizing on an individual's personal information or online activities that she perceives as private. Exposure to behaviorally tailored ads led to increased perceived creepiness, which led to increased threat, increased reactance, negative attitudes toward the ad, and ultimately negative purchase intention toward the featured product. The overall effect on purchase intention was reduced by five percent, indicating that the creepy aspects of behavioral tailoring have a real cost for marketers."

Benefits of Control and Perceived Control

Perceiving one has control of something or a situation, particularly of a stressor, can have positive implications. When people feel they have some control over a stressor--or actually do control it-- the negative implications of experiencing that stressor are reduced (Evans and Cohen, 1987).

Research indicates that, "people are motivated to maintain a consistent level of perceived control. High levels of perceived control are positively associated with better adjustment (e.g., fewer reports of psychopathology, higher self-esteem) and health practices (e.g., less alcohol abuse) as well as improved relationships, interpersonal skills, and emotional functioning. Conversely, social experiences and environmental conditions that create barriers to performance, frustrate goal pursuits, or otherwise threaten to diminish perceived control usually elicit negative

arousal. . . . even the most prodigious powers to perform a particular action would be ineffectual if no reliable contingency was believed to exist between that action and an expected outcome" (Landau, Kay, and Whitson, 2015, pp. 695-696). Mineka and Hendersen report that exposure to uncontrollable events has been linked to greater passivity/anxiety/hostility/depression, and impaired problem solving and ability to fight disease (1985).

Control is important to us at a very fundamental level. Leotti, Iyengar, and Ochsner share that "Belief in one's ability to exert control over the environment and to produce desired results is essential for an individual's wellbeing. It has repeatedly been argued that perception of control is not only desirable, but is also probably a psychological and biological necessity. . . . Converging evidence from animal research, clinical studies and neuroimaging suggests that the need for control is a biological imperative for survival, and a corticostriatal network is implicated as the neural substrate of this adaptive behavior" (2010, p. 457). Also, "It has been found that restriction of behaviors, particularly behaviors that are highly valued by a species, contributes to behavioral and physiological manifestations of stress" (p. 459). And, "In animals and humans, the perception of control over a stressor inhibits autonomic arousal, stress hormone release, immune system system suppression and maladaptive behaviors (e.g. learned helplessness) observed when stressors are uncontrollable. . . . The benefits of perceived control can exist even in the absence of true control over aversive events, or if the individual has an opportunity to exert control but never actually exercises that option" (p. 459).

Thompson defines perceived control as "the combination of an internal locus (i.e., outcomes depend on personal action) and self-efficacy (i.e., I have the skills to take effective action)" (2002, p. 205). Perceived control increases with information about a condition; acceptance of a situation can also increase feelings of control over it. Control has a sort of carryover effect. When people feel that they have control anywhere, they perceive they have control more generally, in other facets of their lives. Culture comes into play as well: "Individuals from collectivist cultures do not derive as much benefit from a sense of personal control as do those from cultures with more individualistic orientations" (Thompson, 2002, p. 209).

Thompson also reports that "a sense of control activates problem solving and attention to solutions" (2002, p. 203). In addition, "Perceived control is beneficial because it is associated with positive emotions, leads to active problem solving, reduces anxiety in the face of stress, and buffers against negative physiological responses" (Thompson, 2002, p. 204).

Research has shown, for instance, that when people are in a positive mood they're better at problem solving (Isen, 2001), creative thinking (Isen, Johnson, Mertz, and Robinson, 1985), and getting along with others (Isen, 2001), and their immune systems also function more effectively (Segerstrom and Sephton, 2010).

How to Increase Perceived - Or Actual - Control

Providing control can enhance well-being in situations related to AD, as material in the last section indicates that the negative effects of stressors can be countered, at least to some extent, by perceived control of related situations.

Researchers have identified four ways that people attempt to restore control in their lives. As Landau, Kay, and Whitson detail "People are motivated to perceive themselves as having control over their lives. Consequently, they respond to events and cognitions that reduce control with compensatory strategies for restoring perceived control to baseline levels" (2015, p. 694). The compensatory strategies available are "bolstering personal agency, affiliating with external systems perceived to be acting on the self's behalf, . . . affirming clear contingencies between actions and outcomes within the context of reduced control (here termed specific structure) . . . [and] affirming nonspecific structure, or seeking out and preferring simple, clear, and consistent interpretations of the social and physical environments" (2015, p. 694). With the fourth compensatory strategy people "sustain interpretations of one's social and physical environments as simple (vs. complex), clear (discernable; not hidden or obscure, vague or ambiguous), and consistent (stable as opposed to erratic; marked by a coherent relation of parts vs. disordered). . . . people will compensate for reduced control by projecting structure on the world, even when no objective structure exists. . . . control reduction will increase affirmation of structured interpretations that do not bear in any straightforward way on the control-reducing condition. In fact, control reduction may increase people's attraction to structured interpretations that they would otherwise find aversive. . . . **people may embrace structure (order) at the cost of viewing themselves as, for example, low in social status, destined to suffer from disease, or victimized by malevolent forces**" (Landau, Kay, and Whitson, 2015, p. 694, p. 697, bold added). In addition "when people represent their goal in relatively more specific terms, they will tend to compensate for reduced control with more direct, proximally relevant strategies" (Landau, Kay, and Whitson, 2015, p. 713).

Culture and other factors also comes into play, "individuals who hold more interdependent models of the self are less likely to see themselves as in control of their fate. . . . Consequently, they may be more likely to compensate by affirming nonspecific structure (order) than individuals socialized in cultural contexts that promote more agentic self-construal." (Landau, Kay, and Whitson, 2015, p. 714).

Landau, Kay, and Whitson repeatedly link control and the establishment of various sorts of order, "Affirming other sources of structured knowledge has also been shown to increase perceived control. Friesen, Kay, et al. (2014) showed that **control reduction leads people to**

prefer social hierarchy over equality. Yet they also observed that the perception of hierarchy in one's workplace (especially hierarchy derived from clear, transparent rules) positively predicted feelings of control in the workplace. The converse is also true: Perceived disorder threatens the individual's sense of personal control. Chae and Zhu (2014) showed that participants who completed tasks in a disorderly (vs. orderly) lab environment felt less in control (p. 715). . . . It has also been demonstrated that orderly (compared with disorderly) environments are negatively associated with creativity and interest in novelty (Vohs, Redden, & Rahinel, 2013). Thus, to the extent compensatory control motives lead people to seek out and prefer orderly, structured environments, it may come at the cost of innovation" (p. 717).

Control, choice, and wellbeing are linked. As Geers, Pose, Fowler, Rasinski, Brown, and Helfer report: "Choosing is the central means by which individuals exert control over their surroundings, and research connects choice with increases in various forms of control including self-efficacy, illusions of control, and self-determination" (2013, pp. 550-551). Research by Geers and his team determined that choices tied to the stressor have more effect on wellbeing than those that do not, with an accompanying greater reduction in negative stressor effects.

Leotti, Iyengar, and Ochsner 2010 clearly link having choices, feeling in control, and wellbeing, "Although much of our behavior is elicited by environmental cues and can be below the state of explicit awareness, all voluntary behavior involves choice. . . . Each choice – no matter how small – reinforces the perception of control and self-efficacy. . . . Choice allows organisms to exert control over the environment by selecting behaviors that are conducive to achieving desirable outcomes and avoiding undesirable outcomes. . . the provision of choice often leads to improved performance on a task. . . . choice can induce greater feelings of confidence and success" (2010, p. 457-459). Choosing has a cultural component, to some extent, "personal autonomy seems to be highly valued in very young children from diverse cultures. . . . Exactly what content is perceived to be included in the personal domain can vary across cultures, but what is important cross-culturally is that the exercise of choice acts to energize and reinforce an individual's sense of agency" (Leotti, Iyengar, and Ochsner, 2010, p. 461).

Iyengar and Lepper completed the landmark study on the amount of choice people feel most comfortable exercising (2000). They found that "psychological theory and research affirm the positive affective and motivational consequences of having personal choice. These findings have led to the popular notion that the more choice, the better—that the human ability to manage, and the human desire for, choice is unlimited. Findings from 3 experimental studies starkly challenge this implicit assumption that having more choices is necessarily more intrinsically motivating than having fewer. . . . . people are more likely to purchase gourmet jams or chocolates or to undertake optional class essay assignments when offered a limited array of 6 choices rather than a more extensive array of 24 or 30 choices. Moreover, participants actually reported greater

subsequent satisfaction with their selections and wrote better essays when their original set of options had been limited" (Iyengar and Lepper, 2000, p. 995). So, the optimal number of choices to provide is, generally, a small, carefully curated set of alternatives.

There is no evidence in the published research of control "creep." "Creep" is defined here as people trying to acquire additional control in new areas after being provided with control in others, previously. For example, after being provided with control of lighting and temperature levels, to use an analogy to the physical world, people do not look to establish control in a new area, such as over the color of light in a space. If control creep existed, it is probable that research programs such as Iyengar's continuing investigations of choice could have identified it.

Patients are often required to make choices during the course of their treatments. Geers, Pose, Fowler, Rasinski, Brown, and Helfer share that "In modern health care, individuals frequently exercise choice over health treatment alternatives. A growing body of research suggests that when individuals choose between treatment options, treatment effectiveness can increase. . . . This research suggests that when individuals desire control [see later sections of this paper for information on situations where control may not be desirable], choice over treatment alternatives improves treatment effectiveness by enhancing personal control. . . . Studies across numerous treatment domains provide evidence that increased personal involvement, perceptions of choice, and maximization of fit between patient preferences and treatments can benefit treatment satisfaction and increase compliance. . . . Research has also uncovered evidence that treatment effects are stronger in cases when individuals actively participate in treatment decision making" (2013, pp. 549-550).

Field research indicates that control is valuable ("Study: Workplace Flexibility Benefits Employees," 2016). Moen, Kelly, and their team learned via data collected over 12 months in an IT division of a Fortune 500 company that after "half the [studied] work groups participated in a pilot program, where they learned about work practices designed to increase their sense of control over their work lives. . . . Employees then implemented these practices, which ranged from shifting their work schedules and working from home more to rethinking the number of daily meetings they attended, increasing their communication via instant messenger, and doing a better job of anticipating periods of high demand, such as around software releases. . . . The control group was excluded from the training. . . . employees who participated in the organizational initiative said they felt more control over their schedules, support from their bosses. . . . these employees reported greater job satisfaction and were less burned out and less stressed. . . . Previous studies have shown that organizational initiatives that improve employees' subjective wellbeing also improve the bottom line: they increase productivity and decrease absenteeism, turnover, and presenteeism—which means showing up, but not being engaged at

work." This research by Moen, Kelly and others will be published in the *American Sociological Review.*

Resilience is "a construct representing the maintenance of positive adaptation despite significant adversity" (Infurna and Luthar, 2016, p. 175). A certain sort of person is most likely to be resilient, "A convergence across several research methodologies indicates that resilient individuals have optimistic, zestful, and energetic approaches to life, are curious and open to new experiences, and are characterized by high positive emotionality. . . . Additional evidence suggests that high-resilient people proactively cultivate their positive emotionality by strategically eliciting positive emotions through the use of humor (Werner & Smith, 1992), relaxation techniques (Demos, 1989; Wolin & Wolin, 1993), and optimistic thinking (Kumpfer, 1999). Positive emotionality, then, emerges as an important element of psychological resilience" (Tugade and Fredrickson, 2004, p. 320).

In 2016, Konnikova discussed the issue of resilience and resilience training in a science-based review that appeared in *The New Yorker.* Having an internal locus of control, in other words, the feeling of directing your own destiny, as opposed to living at the whim of fate, is linked to higher levels of resilience (similarly discussed by Gifford in his review of the stress that accompanies experiencing a natural disaster (2014)). Konnikova reports on several successful resilience training programs. For example: "In research at Columbia, the neuroscientists Kevin Ochsner has shown that teaching people to think of stimuli in different ways--to reframe them in positive terms when the initial response is negative, or in a less emotional way when the initial response is emotionally 'hot'--changes how they experience and react to the stimulus. You can train people to better regulate their emotions, and the training seems to have lasting effects." Also, Seligman found that training people to change their explanatory styles from internal to external ('This is one narrow thing rather than a massive indication that something is wrong with my life'), and from permanent to impermanent ('I can change the situation, rather than assuming it's fixed') made them more psychologically successful and less prone to depression. The same goes for locus of control . . . .: not only is a more internal locus tied to perceiving less stress and performing better but changing your locus from external to internal leads to positive changes to both psychological well-being and objective work performance. The cognitive skills that underpin resilience, then, seem like they can indeed be learned over time, creating resilience where there was none." It is, unfortunately, also possible for people to spontaneously become less resilient, for example, when they ruminate on a topic, but these negative developments can be attacked via training.

A primary mechanism for remediating the negative effects of AD is providing situational control to those who have, or may, experience it. Control can be established before or after AD occurs. Opportunities for increasing control include providing people with:

1. Ability to restrict what others can learn about them
2. Information about the potential AD situation, processes involved, etc. This could take the form of advance warnings. Information can also increase the predictability of stressful situations, which can reduce their negative psychological ramifications.
3. Ability to opt in or out of a potential AD-related situation and to generally define events they experience, as well as to determine the demographic, etc., groups to which they are linked
4. Access to a support system, human or electronic
5. Options for reporting negative situations to an enforcement group
6. Option to determine what they see/learn after an AD event
7. Material to support problem- or emotion-focused coping--for example, options to take actions to change aversive elements of the situation, a more logic-based response (problem-focused coping) or insights that can help reconceptualize the situation via a change in the way it is assessed emotionally (emotion-focused coping), by, for example, categorizing a situation as not actually important or as somehow actually a positive event.

This list of control options indicates the range of choices that can be provided to people who have or may experience AD. Providing too many choices is counterproductive, however, and the options listed above appear in order of their expected value for preventing and countering the negative effects of AD. Supplying opportunities for people to re-establish feelings of personal agency are particularly important. Some options listed are, no doubt, more feasible to implement than others, so a range of possibilities are shared; the six types of control identified by Fiske and Taylor should be thoroughly reviewed to identify potential opportunities to reduce the negative effects of uncontrolled AD-stress. (The six types of control identified by Fiske and Taylor are reflected in the list presented in this paragraph.)

An important way to remediate AD situations is via external reporting mechanisms, for example, channels that people who feel they have experienced AD can use to reach powerful organizations perceived to be concerned about AD. Association with powerful groups can also help re-establish feelings of control. At minimum, these contacts would provide ways for people who have experienced AD to express their feelings and receive emotional/social support, which can reduce the negative consequences of being stressed. Development of a therapeutic community is particularly desirable.

Laying out a process to remediation is consistent with Landau, Kay and Whitson's finding that perceptions of order can help restore wellbeing after stressful situations.

External reporting restores perceptions of control, whether people exercise their contact options or not, and actual control when they do. Any actual contact, if it involves relatively "easy" tasks,

can also counter learned helplessness, as discussed by Mineka and Hendersen (1985). Learned helplessness also becomes less likely if the options available to control AD-related experiences are well publicized. To reduce the potential for reactance, any sort of communication related to AD must make it clear to people with potential/actual AD-related experiences that they have the opportunity to make choices that determine their experience of AD-related events and must also provide people with warnings of potential AD-related threats.

The form of/information conveyed by external reporting mechanisms and choices provided, generally, should recognize Simonton's work (in press) detailing how humans respond to situations. Both can, specifically, change knowledge of utility (v), as well as actual utility (u) and probability (p) of a situation. Increasing the likelihood of a routine type response makes the repercussions of an AD-related event more predictable using Simonton's response typology system, because as described in the How People Respond to Situations section above, u, v, and p would all be approaching 1. Simonton describes routine behavior in this way: "such responses make up the knowledge and skill that allows each and every one of us to adapt readily to our world, including the expertise that permits us to succeed in most jobs and professions. Such thoughts and behaviors are often equivalent of if-then statements, such as 'if this happens, then do that'."

The development of external reporting mechanisms can also supply information that supports the use of the availability heuristic, for example, with prospective and actual AD experiences, potentially reducing the severity of stress reactions.

External reporting mechanisms can also involve implementing facets of resilience training which Konnokova has effectively reviewed (2016).

Communication tools (websites, etc.) that establish external reporting mechanisms or generally work to re-establish control, via choices, etc., should follow the stress-minimizing design criteria outlined next in this document.

Other Ways (Besides Psychological Control) to Counter Stressors

There are a variety of ways, not outlined in the last section, to temper, or attempt to temper, the influence of stressors on psychological and physical wellbeing. Reviewing them here provides additional insights on ways to counter the negative effects of AD, primarily via the design of websites and other communication tools.

Sensory experiences that bring us mentally back to the sorts of places where humans felt comfortable eons ago, when we were a young species, are great stress reducers today. Our early years as a species continue to influence the visually complexity and sorts of lines found in calming stimuli, for example. When people are learning that they have experienced AD and how they might, to some extent, alleviate the negative consequences of these events, using the design principles described in the paragraphs that follow on screens, etc., viewed can reduce the negative consequences of AD-related stress experienced. Calming can, in general, be anticipated to support the sort of focused work that will generally be required to overcome AD-related events.

Seeing curving lines comforts humans (Bar and Neta, 2006). Objects and patterns with curved features are also preferred to those with pointed features and sharp angles. Bar and Neta feel that pointier shapes may be linked to, and call to mind, threatening situations, such as looking into the mouth of a large, attacking mammal. Research has shown that "angular v-shaped images (similar to the angles in the eyebrows, cheeks, chin, and jaw in angry expressions) and rounded images (similar to the curves found in the cheeks, eyes, and mouth in happy expressions) conveyed an angry and happy meaning respectively" (Larson, Aronoff, and Stearns, 2007, p. 526).

Moderate levels of environmental stimulation are best, "Either too much (overload) or too little stimulation (sensory deprivation) in the environment is said to produce stress. Physical variables related to stimulation load include the intensity of stimulation, the complexity or variety of stimulation, novelty, ambiguity, conflict or inconsistent sources of information, and, finally, instability or change" (Evans and Cohen, 1987, p. 578). AD alleviation related websites should thus involve only a few colors and shapes, with the colors in use being positioned close to each other on the color wheel, for example.

Pheasant, Fisher, Watts, Whitaker and Horoshenkov indicate that a stress reducing space cannot be understimulating; if they are, we don't engage with them (2010). As a result, computer screens cannot be too simple, moderate visual complexity is the goal. A NASA press release quotes Dr. Jack Stuster as stating that "'Monotony of stimulation . . . can be a serious source of stress'" ("Zinnias from Space! NASA Studies the Multiple Benefits of Gardening," 2016).

Valdez and Mehrabian (1994) have determined that colors that are less saturated and relatively bright are relaxing to look at while those that are more saturated and less bright are energizing to see. Brightness refers to how light a color appears to be, i.e., how much white appears to have been mixed into the paint. Saturation is how "grayed out" a color seems to be. Sage green is less saturated than Kelly green, for example. A bright sage green is a good background color for a screen if calming viewers is desired.

Seeing particular sorts of scenes, "live" or in still images, can reduce stress. Using the same sort of imagery on AD mitigation related websites, etc., can, to some extent, minimize the negative implications of having experienced AD.

A view of nature, water, and similar scenes "live" or in realistic art can capture our attention and help counter the effects of stressors on our psychological and physical wellbeing (Kaplan, 1995). Nature images that produce the most positive response are those that we feel we might step into. They depict open fields with a few scattered trees; jungle scenes increase our stress levels (Ulrich and Gilpin, 2003). Van den Berg, Koole, and van der Wulp, among many others, have also found that viewing nature enhances mood as well as our ability to concentrate, while reducing stress (van den Berg, Koole, and van der Wulp, 2003). Functional MRI data, confirms that views of nature reduce human stress levels (Kim, Jeong, Baek, Kim, Sundaram, Kang, Lee, Kim, and Song, 2010). Looking at scenes of nature, live or as still or moving images, influences the activity in our brains, and has been linked to alpha wave frequencies tied to relaxed states (Berto, 2014).

A view of an urban environment that is fascinating is restorative/stress busting, but identifying de-stressing urban design is difficult (Berto, Baroni, Zainaghi, and Bettella, 2010). As Berto and her team report, for an urban scene to be restorative it must capture and easily hold our attention, i.e., be fascinating, which is a higher standard than that required of natural scenes. A fascinating urban image might feature sunlit sculpted surfaces, which change gently, as branches casting shadows move in a slight breeze, for example. To be restorative and reduce stress when viewed, it must seem like a space that can be fully explored over time, which is consistent with having moderate visual complexity.

Watching fish swim in an aquarium is good for our mental wellbeing and reducing stress (Berry, Parker, Coile, Hamilton, O'Neill, and Sadler, 2004). It invites exploration, but seems to preclude unexpected negative events because of its moderate visual complexity.

Fell found that seeing "wood provides stress-reducing effects similar to the well studied effect of exposure to nature in the field of environmental psychology" (2010). This leads to the conclusion that "wood may be able to be applied indoors to provide stress reduction as a part of the evidence-based and biophilic design of hospitals, offices, schools, and other built environments." If background patterns are needed on AD-related websites, ones similar to wood grain are desirable.

Sometimes websites are soundscaped. If AD mitigation-related websites have an audio component, there are some sorts of sounds that are much more desirable to use than others.

Natural sounds effectively support recovery from stressful events (Benfield, Taff, Newman, and Smyth, 2014). The natural sounds tested by Benefield and his team were the sounds of birds singing and gently rustling leaves.

Humans are more comfortable in biophilicly designed spaces and one of the features of a biophilcly designed space is a view out over the nearby area from a protected space--for example, a view into a valley from a safe, mountain lion-free cave (Heerwagen and Gregory, 2008). The online equivalent of having this sort of prospect and refuge would be an overview of events to come provided by a trusted source. The overview can be provided via text and graphics in the main body of messages as well as in accompanying sidebars. The design of communication tools must also support completion of the task at hand, avoiding any stress-inducing distractions (the implications of these stressors were described in an earlier section of this document).

Nonverbal messages can influence stress experienced. Those that are inconsistent with an organization's mission and goals generate stress (Vischer, 2007) and should be avoided in communication channels.

Erving Goffman (1959) famously elaborated the concept of front and back stage areas. In front stage spaces, actions and messages are visible to all: employees and others affiliated in some way with the owning organization as well as members of the general public. Back stage areas aren't seen by members of the public. In most cases, discrepancies between front and back stages and the messages sent by each generate stress and unhappiness among the workers and others who are familiar with both—when different messages are sent by each area, front stages almost inevitably present more positive "stories" about supporting human wellbeing and similar issues than those transmitted from back stages. Some of the messages found in a particular place are known only to members of particular user groups and others are familiar to people from the entire society who might potentially visit a space (Goffman, 1959).

During a study to be published in *Social, Cognitive and Affective Neuroscience*, a team led by Anke Karl found that "Being shown pictures of others being loved and cared for reduces the brain's response to threat. . . . being reminded of being loved and cared for dampens the threat response and may allow more effective functioning during, and activation of soothing resources after, stressful situations" ("Brain's Response to Threat Silenced," 2014). Images even affected study participants not paying attention to the content of the pictures. Data were collected using fMRI machines.

When people are stressed, they select familiar options, even when their experiences with those familiar choices are not positive (Litt, Reich, Maymin, and Shiv, 2011). The devil you know

may not be the most desired option when people are stress-free, but in a stressful situation, people may readily select it if other options aren't available. When designing websites, etc., in conjunction with remedying the negative effects of AD, familiar sorts of design options are preferable to the avant garde. (Litt, Reich, Maymin, and Shiv, 2011).

Grosskopf got reactions to images of antiterrorism measures (2006) and his findings have repercussions for the presentation of information in AD-related information channels. Some images used showed clearly recognizable security features (guards and screening stations), others concealed security features. In Grosskopf's first study, more visible security lead respondents to feel safer, and study participants reported they thought the likelihood of theft, battery or sexual assault to be three to six times lower in the areas with obvious safety measures. In a subsequent study, people primed to think about terrorism saw photos of seven security areas, four with visible security measures (guard with guns, security cameras, razor wire, and K-9 handler with a dog) and three with less obvious measures (bollards, lighting, and a planter-barrier). People responded to the visible security photos with negative emotions, while they responded to the concealed measures with positive, restful ones. Grosskopf concludes that visible security measures make people tense and fearful when they are being used in an antiterrorism context, but the same visible security measures are well received when they are being used to combat conventional crimes, such as theft. The researcher suggests that these active antiterrorism measures may reinforce people's feelings of vulnerability to an uncertain threat, and thus generate negative emotions.

Additional research indicates that security measures need to be thoughtfully integrated into communication channels: viewing a closed circuit television camera in use makes people think more seriously about potential threats that may be nearby (Williams and Ahmed, 2009).

When Control Is Undesirable

Control can be a burden: "When the response required to exert control is very difficult, control may be as stressful as lack of control" (Mineka and Hendersen, 1985, p. 505).

Geers, Pose, Fowler, Rasinski, Brown and Helfer, agree that "having choice and control is not always advantageous. . . . That is, we found that the benefit of choice was restricted to individuals who wanted a high level of personal control. . . . individuals tend to desire less personal control when they perceive themselves as not having the resources or abilities to maximize their positive outcomes" (2013, p. 561-562).

Leotti, Iyengar, and Ochsner report that "Choice might not be desirable in all situations, particularly in the context of complex or emotionally difficult decisions. However, there might

be a difference between the desire to have choices and the desire to make choices. . . . a recent study investigating choice preferences in the context of healthcare revealed that of the 823 study participants, 95.6% indicated that having choices was extremely important, whereas only 30.3% indicated that making choices was extremely important. . . . If we are motivated to choose the best option, then choosing a non-optimal option means that we were unsuccessful; thus, avoiding a decision might reflect anticipatory regret or fear of failure or blame for poor decisions. This might explain why people tend to defer to default options (i.e. the status quo) when choice difficulty is increased. . . . In the absence of sufficient knowledge or resources to make an optimal decision, choice by a proxy agent, such as a trusted friend, family member or physician, might be more desirable than personal choice. In any case, individuals are still exercising control by choosing to engage in or to abstain from decisions to promote their best interest" (2010, p. 461).

Some AD situations might be ones in which control is onerous, as described above, but most are not.

Individual Differences and Stressors

Personal factors influence responses to potentially stressful physical situations. Relevant ones include life history, coping styles, beliefs about self-efficacy/mastery, the importance of goals whose achievement is threatened by the stressor, and social resources (Evans and Cohen, 1987), which have been discussed earlier in this report. Cultural norms can influence expected and accepted responses to stressors (Evans and Cohen, 1987), which was also discussed in a previous section.

External locus of control and learned helplessness have been linked. Hiroto found that "externals were significantly more helpless than internals" (1974, p. 187).

In addition, "relative to individuals with Type B personalities, individuals with Type A personalities become more energized by initial perceived threats of loss of control (reactance), and more withdrawn or helpless with prolonged exposure to uncontrollable stimulation" (Mineka and Hendersen, 1985, p. 506).

Conclusion

Integrating research on multiple types of stressful experiences makes it clear that AD has negative, tension-inducing implications, but that it is possible to reduce the undesirable effects of AD by providing people with control over aspects of AD-related situations and resilience

training. External reporting mechanisms and communication tools can be designed to dampen the negative effects of AD.

Acknowledgments

We thank Sarah Fox, Vinay Goel, and Giles Hogben for thoughtful comments on this work.

References

American Psychological Association. 2016. *Stress in America: The Impact of Discrimination*, Stress in America ™ Survey.

Michelle Andrews, Xueming Luo, Zheng Fang, and Anindya Ghose. 2015. "Mobile Ad Effectiveness: Hyper-Contextual Targeting with Crowdedness." *Marketing Science, vol. 35*, no. 2, pp. 218-233.

Michael Apter. 2007. *Reversal Theory: The Dynamics of Motivation, Emotion and Personality.* Oneworld: Oxford, England.

Michael Argyle and Janet Dean. 1965. "Eye-Contact, Distance and Affiliation." *Sociometry, vol. 28*, no. 3, pp. 289-304.

Moshe Bar and Maital Neta. 2006. "Humans Prefer Curved Visual Objects." *Psychological Science, vol. 17*, no. 8, pp. 645 – 648.

Lisa Barnard. 2015. "The Cost of Creepiness: How Online Behavioral Advertising Affects Consumer Purchase Intention." *Dissertation Abstracts International Section A: Humanities and Social Sciences, Vol 75(9-A(E)),* no pagination specified.

Andrew Baum and Paul Paulus. 1987. "Crowding." In Daniel Stokols and Irwin Altman (eds.), *Handbook of Environmental Psychology, volume* 1, John Wiley and Sons: New York, pp. 533-570.

Jacob Benfield, B. Taff, Peter Newman, and Joshua Smyth. 2014. "Natural Sound Facilitates Mood Recovery." *Ecopsychology, vol. 6*, no. 3, pp. 183-188.

Leonard Berry, Derek Parker, Russell Coile, D. Kirk Hamilton, David O'Neill, and Blair Sadler. 2004. "The Business Case for Better Buildings." *Frontiers of Health Services Management*, *vol. 21,* no. 1, pp. 3–24.

Rita Berto. 2014. "The Role of Nature in Coping with Psycho-Physiological Stress: A Literature Review on Restorativeness." *Behavioral Sciences, vol. 4*, pp. 394-409.

R. Berto, M. Baroni, A. Zainaghi, and S. Bettella. 2010. "An Exploratory Study of the Effect of High and Low Fascination Environments on Attentional Fatigue." *Journal of Environmental Psychology, vol. 30*, pp. 494-500.

"Brain's Response to Threat Silenced." 2014. Press release, University of Exeter, http://www.exeter.ac.uk/news.

Kate Crawford. 2016. "Artificial Intelligence's White Guy Problem." *The New York Times,* http://www.nytimes.com/2016/06/26/opinion/sunday/artificial-intelligences-white-guy-problem.html?emc=eta1&_r=0.

Gary Evans and Sheldon Cohen. 1987. "Environmental Stress." In Daniel Stokols and Irwin Altman (eds.) *Handbook of Environmental Psychology, volume 1*, John Wiley and Sons: New York, pp. 571-610.

Gary Evans, and Dana Johnson. 2000. Stress and open-office noise. *Journal of Applied Psychology, vol. 85*, no. 5, pp. 779–783.

David Fell. 2010. "Wood in the Human Environment: Restorative Properties of Wood in the Built Indoor Environment." Dissertation, The University of British Columbia.

S. Fiske and S. Taylor. 1991. *Social Cognition.* McGraw-Hill: New York.

Andrew Geers, Jason Pose, Stephanie Fowler, Heather Rasinski, Jill Brown, and Suzanne Helfer. 2013. "Why Does Choice Enhance Treatment Effectiveness? Using Placebo Treatments to Demonstrate the Role of Personal Control." *Journal of Personality and Social Psychology, vol. 105*, no. 4, pp. 549-566.

Peter Gianaros and Tor Wager. 2015. "Brain-Body Pathways Linking Psychological Stress and Physical Health." *Current Directions in Psychological Science, vol. 24*, no. 4, pp. 313-321.

Robert Gifford. 2014. *Environmental Psychology, Fifth Edition.* Optimal Books: Colville, WA.

Erving Goffman. 1959. *The Presentation of Self in Everyday Life.* Anchor: New York.

Kevin Grosskopf. 2006. "Evaluating the Societal Response to Antiterrorism Measures." *Journal of Homeland Security and Emergency Management, vol. 3*, no. 2, pp. 1-9.

Judith Heerwagen and Bert Gregory. 2008. "Biophilia and Sensory Aesthetics." In Stephen Kellert, Judith Heerwagen, and Martin Mador (eds). *Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life*. Wiley: Hoboken, NJ, pp. 227-241.

Donald Hiroto. 1974. "Locus of Control and Learned Helplessness." *Journal of Experimental Psychology, vol. 102*, no. 2, pp. 187-193.

T. Holmes and R. Rahe. 1967. "The Social Readjustment Rating Scale." *Journal of Psychosomatic Research, vol. 213*, no. 2, pp. 213-218.

Ying Hua, Vivian Loftness, Judith Heerwagen, and Kevin Powell. 2011. "Relationship Between Workplace Spatial Settings and Occupant-Perceived Support for Collaboration." *Environment and Behavior, vol. 43*, no. 6, pp. 807-826.

Frank Infurna and Suniya Luthar. 2016. "Resilience to Major Life Stressors Is Not as Common as Thought." *Perspectives on Psychological Science, vol. 11*, no. 2, pp. 175-194.

Mike Isaac. 2016. "Facebook 'Trending' List Skewed by Individual Judgment, Not Institutional Bias." *The New York Times*, http://www.nytimes.com/2016/05/21/technology/facebook-trending-list-skewed-by-individual-judgment-not-institutional-bias.html?emc=eta1&_r=0

Alice Isen. 2001. "An Influence of Positive AFfect on Decision Making in Complex Situations: Thoeretical issues with Practical Implications." *Journal of Consumer Psychology, vol. 11*, no. 2, pp. 75-85.

A.Isen, M. Johnson, E. Mertz, and G. Robinson. 1985. "The Influence of Positive Affect on the Usualness of Word Associations,' *Journal of Personality and Social Psychology, vol. 48,* no.6, pp. 1413-1426.

Sheena Iyengar and Mark Lepper. 2000. "When Choice is Demotivating: Can One Desire Too Much of a Good Thing?" *Journal of Personality and Social Psychology, vol. 79*, no. 6, pp. 995-1006.

Daniel Kahneman. 2011. *Thinking Fast and Slow*. Farrar,Straus, and Giroux: New York.

S. Kaplan. 1995. "The Restorative Benefits of Nature: Towards an Integrative Framework." *Journal of Environmental Psychology, vol. 15*, pp. 169-182.

Jeansok Kim and David Diamond. 2002. "The Stressed Hippocampus, Synaptic Plasticity and Lost Memories." *Nature Reviews Neuroscience, vol. 3*, pp. 453-462.

Tae-Hoon Kim, Gwang-Woo Jeong, Han-Su Baek, Gwang-Won Kim, Thirunavukkarasu Sundaram, Heoung-Keun Kang, Seung-Won Lee, Hyung-Joong Kim, and Jin-Kyu Song. 2010. "Human Brain Activation in Response to Visual Stimulation with Rural and Urban Scenery Pictures: A Functional Magnetic Resonance Imaging Study." *Science of the Total Environment, vol. 408*, pp. 2600-2607.

Maria Konnokova. 2016. "How People Learn to Become Resilient." *The New Yorker*, http://www.newyorker.com/science/maria-konnikova/the-secret-formula-for-resilience

S. Lamb and K. Kwok. 2016. "A Longitudinal Investigation of Work Environment Stressors on the Performance and Wellbeing of Office Workers." *Applied Ergonomics, vol. 52*, pp. 104-111.

Mark Landau, Aaron Kay, and Jennifer Whitson. 2015. "Compensatory Control and the Appeal of a Structured World." *Psychological Bulletin, vol. 141*, no. 3, pp. 694-722.

Christine Larson, Joel Aronoff, and Jeffrey Stearns. 2007. "The Shape of Threat: Simple Geometric Forms Evoke Rapid and Sustained Capture of Attention." *Emotion, vol. 7*, no. 3., pp. 526-534.

Lauren Leotti, Sheena Iyengar, and Kevin Ochsner. 2010. "Born to Choose: The Origins and Value of the Need for Control." *Trends in Cognitive Sciences, vol. 14,* no. 10, pp. 457-463.

Shu Li and Yan-Mei Li. 2007. "How Far is Far Enough? A Measure of Information Privacy in Terms of Interpersonal Distance." *Environment and Behavior, vol. 39*, no. 3, pp. 317-331.

Bing Lin, Jason Kain, and Charlotte Fritz. 2013. "Don't Interrupt Me! An Examination of the Relationship Between Intrusions at Work and Employee Strain." *International Journal of Stress Management, vol. 20*, no. 2, pp. 77-94.

Michael Lindell. 2012. "Response to Environmental Disasters." Susan Clayton (ed.), *Oxford Handbook of Environmental and Conservation Psychology*, Oxford University Press: New York, pp. 391-413.

Ab Litt, Taly Reich, Senia Maymin, and Baba Shiv. 2011. "Pressure and Perverse Flights to Familiarity." *Psychological Science, vol. 22*, no. 4, pp. 523-531.

Ahreum Maeng. 2014. "Crowding and Mental Representation." *Dissertation Abstracts International Section A: Humanities and Social Sciences, vol. 74(11-A(E)),* 2014, no pagination specified.

Benjamin Meagher and Kerry Marsh. 2015. "Testing an Ecological Account of Spaciousness in Real and Virtual Environments." *Environment and Behavior, vol. 47*, no. 7, pp. 782-815.

Claire Cain Miller, 2015. "When Algorithms Discriminate." *The New York Times,* http://www.nytimes.com/2015/07/10/upshot/when-algorithms-discriminate.html

Susan Mineka and Robert Hendersen. 1985. "Controllability and Predictability in Acquired Motivation." In *Annual Review of Psychology, vol. 36*, pp. 495-529.

"One-Third of Workers Say Office Temperature Affects Their Productivity, Finds New CareerBuilder Survey." 2010. Press release, CareerBuilder, http://www.careerbuilder.com

Robert Pheasant, Mark Fisher, Greg Watts, David Whitaker, and Kirill Horoshenkov. 2010. "The Importance of Auditory-Visual Interaction In the Construction of 'Tranquil Space.'" *Journal of Environmental Psychology, vol. 30*, no. 4, pp. 501-509.

Aram Seddigh, Erik Bentsson, Christina Danielson, and Hugo Westerlund. 2014. "Concentration Requirements Modify the Effect of Office Type on Indicators of Health and Performance." *Journal of Environmental Psychology, vol. 38*, pp. 167-174..

Suzanne Segerstrom and Sandra Sephton. 2010. "Optimistic Expectancies and Cell-Mediated Immunity: The Role of Positive Affect." *Psychological Science, vol. 21,* no. 3, pp. 448-455.

Dean Simonton. "Creativity, Automaticity, Irrationality, Fortuity, Fantasy, and Other Contingencies: An Eightfold Response Typology." *Review of General Psychology*, in press.

Christine Sprigg, Christopher Stride, Toby Wall, David Holman, and Phoebe Smith. 2007. "Work Characteristics, Musculoskeletal Disorders, and the Mediating Role of Psychological Strain: A Study of Call Center Employees." *Journal of Applied Psychology, vol. 92*, no. 5, pp. 1456-1466.

A. Spurgeon, C. Jackson, and J. Beach. 2001. "The Life Events Inventory: Re-Scaling Based on an Occupational Sample." *Occupational Medicine, vol. 51*, no. 4, pp. 287-293.

Arthur Stamps. 2011. "Effects of Area, Height, Elongation, and Color on Perceived Spaciousness." *Environment and Behavior, vol. 43*, no. 2, pp. 252-273.

Christina Steindl, Eva Jones, Sandra Sittenthaler, Eva Traut-Mattausch, and Jeff Greenberg. 2015. "Understanding Psychological Reactance: New Developments and Findings." *Zeitschrift fur Psychologie, vol. 223*, no. 4, pp. 205-214.

"Study: Workplace Flexibility Benefits Employees." 2016. Press release, American Sociological Association, http://www.asanet.org/press/workplace_flexibility.cfm

Suzanne Thompson. 2002. "The Role of Personal Control in Adaptive Functioning." In C. Snyder and Shane Lopez (eds.), *Handbook of Positive Psychology,* Oxford University Press: New York pp. 202-213.

Michele Tugade and Barbara Fredrickson. 2004. "Resilient Individuals Use Positive Emotions to Bounce Back from Negative Emotional Experiences." *Journal of Personality and Social Psychology, vol. 86*, no. 2, pp. 320-333.

R. Ulrich. 1991. "Effects of Interior Design on Wellness: Theory and Recent Scientific Research." *Journal of Health Care Interior Design, vol. 3*, oo. 97-109.)

R. Ulrich and L. Gilpin. 2003. "Healing Arts: Nutrition for the Soul." In S. Frampton, L. Gilpin, and P. Charmel (eds.), *Putting Patients First: Designing and Practicing Patient-Centered Care*, San Francisco, CA: John Wiley and Sons, pp. 117-146.

Patricia Valdez and Albert Mehrabian. 1994. "Effects of Color on Emotions." *Journal of Experimental Psychology: General, vol. 123*, no. 4, pp. 394–409.

A.van den Berg, S. Koole, and N. van der Wulp. 2003. "Environmental Preference and Restoration: (How) Are They Related? *Journal of Environmental Psychology, vol. 23*, pp. 135-146.

Jacqueline Vischer. 2007. "The Effects of the Physical Environment on Job Performance: Towards a Theoretical Model of Workspace Stress." *Stress and Health, vol. 23*, no. 3, pp. 175-184.

Meifen Wei, Tsun-Yao Ku, Daniel Russell, Douglas Bonett, and Alvin Alvarez. 2010. "Development and Validation of a Coping with Discrimination Scale: Factor Structure, Reliability, and Validity.: *Journal of Counseling Psychology, vol. 57*, no. 3, pp. 328-344.

Dave Williams and Jobuda Ahmed. 2009. "The Relationship Between Antisocial Stereotypes and Public CCTV Systems: Exploring Fear of Crime in the Modern Surveillance Society. *Psychology, Crime and Law, vol. 15*, no. 8, pp. 743-758.

"Your Stress is My Stress: Merely Observing Stressful Situations Can Trigger a Physical Stress Response." 2014. Press release, Max Planck Institute, http://www.mpg.de/8167448/stress-empathy

"Zinnias from Space! NASA Studies the Multiple Benefits of Gardening." 2016. Press release, National Aeronautics and Space Administration, http://www.nasa.gov/content/ZINNIAS-FROM-SPACE-NASA-Studies-the-Multiple-Benefits-of-Gardening