

Applying reward versus punishment psychology to the wildland fire suppression culture

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Abstract

Presented is the struggle between safety and human nature. Safety psychologists are in general agreement that it is high-risk behavior that leads to the majority of accidents and near-hits. This behavior evolves from a reward versus punishment relationship where high-risk behavior is seldom punished by an accident or injury and may well produce rewards. In such situations these rewards can serve to reinforce this behavior as both safe and acceptable. Thus the manner in which high-risk behavior is rewarded or punished contributes extensively to the resulting safe or unsafe culture.

Since 1935 aggressive initial attack in the pursuit of 10 A.M. fire control has produced astounding results for agencies in the business of strict fire control. Aggressive fire suppression has produced initial attack success rates in excess of 90% in some of the most intense of fire regimes. Such astounding success (reward) has entrenched this strategy such that it has become an icon for fire control agencies. It has led to unachievable expectations and therefore pressures from both the public and the fire suppression culture itself.

It can be easily rationalized that the application of a business strategy that produces positive results over 90% of the time could only improve if it were applied more rigorously. This logic has indeed been applied to the wildland fire control business as witnessed in countless fire reviews and investigations.

It is however wildland fires burning under what are relatively infrequent conditions of extreme fire behavior where nature demonstrates its considerable dominance over fire suppression technology. Fires burning under these conditions also account for the majority of area burned and put firefighter lives in greatest peril from wildfire entrapments.

There is a turning point in the fire environment where aggressive fire suppression may reduce the threat to lives and property and where it will not. Beyond this point it is simply high risk and low reward. In terms of risk management, managers need to identify these conditions and adopt appropriate measures.

Introduction

The principle that accidents are the culmination of a chain of events consisting of numerous causal factors has widespread acceptance. In the wildland fire business, such factors frequently include: communications; fire behavior; strategies and tactics; equipment; and various violations of the 10 Standard Fire Orders and 18 Watch Out Situations (10 & 18). Where human behavior factors have been identified as contributing to accidents to at least some degree, it is frequently referenced as the much maligned "Can Do Attitude". While an admirable quality by many accounts and an acceptable practice under many wildland fire circumstances, "Can Do" can produce disastrous consequences if not tempered by a strong measure of reality.

Fatality investigations will frequently categorize causal factors according to the manner in which they may have contributed to the incident. Mangun (1995) suggests a classification format that includes the manner in which the causal factor may have contributed (directly or indirectly) plus the extent to which the factor may have contributed (influencing or contributing significantly). Such a format is generally oriented to proximal cause identification for the purpose of developing new procedures, equipment or standards to eliminate or reduce the risk. Braun (1995) argues that this is far too myopic and it is the human factors that influence the acceptance of hazardous and risky behavior that need to be investigated. This sentiment reflects Heinrich's "Law of Safety" who, like Braun, implicates high-risk behavior as the source of most near-hits and accidents (Heinrick et al 1980).

In this respect, causal factors relating to near-hits and/or fatalities from wildland fire entrapments can be generalized as either fire behavior or human behavior. While there has been much research regarding fire behavior in the past decades there has been little research into the attitudes and behaviors of the wildland fire suppression culture. Wildland fire behavior largely conforms to principles of chemistry and physics while human behavior in comparison is far more complex and at times doesn't appear to conform at all.

In appreciation that human behavior is motivated by consequences either good or bad (Geller 1996), the very successes and failures of the fire suppression business need to be examined with respect to the impact they may have on the wildland fire culture specifically.

Common denominators revised

Wilson's Common Denominators (Wilson 1977) are as relevant today as they were over 25 years ago. His observations however focused largely upon factors of the fire environment (i.e. light fuels, fires ran upslope, unexpected wind switch and/or increase). In terms of human behavior factors what is missing from Wilson's Common Denominators is the associated activity. Putnam (1995) and Mangun (1999) report that entrapment fatalities, injuries, and near-hits are most likely to occur during initial attack phases or extended initial attack periods in transition to sustained attack operations. A combination of these observations reasons that the majority of entrapment related accidents and near-hits share two common elements

1. Extreme fire environment conditions.
2. Initial attack or initial attack transition to sustained attack phases.¹

This was most certainly true of some of North America's most highly publicized wildland fires. Such as the Mann Gulch Fire (McLean 1992), Dude Fire (USDA 1999), South Canyon Fire (South Canyon Fire Investigation 1994), Thirtymile Fire (USDA 2001) plus many others. If conditions of the fire environment are largely beyond the control of the fire manager, then it is the phases of initial attack over which some degree of management control may be exercised, that need to be examined.

What then makes the initial attack phase of fire suppression operations so susceptible to entrapment fatalities, injuries and near-hits? Mangun (1999) summarizes it as the period when firefighters may be taking independent action in an environment where

¹ Although the condition of extreme fire behavior and initial attack are common to wildland fire entrapments it is not absolute and appropriate caution should be exercised on all wildland fires regardless of the fire behavior or phase of operation.

communications might be confused and the fire environment conditions not well understood. One might also argue that in any given year there would be far more initial attack fires than there would be extended attack fires. Data on related person hours of exposure to each is not readily available.

Learning to be at risk

Geller (1996) recognizes risk taking as a learned behavior that develops from a risk and reward or punishment relationship. Risk taking or unsafe acts are in reality, seldom punished by an injury or even a near-hit. In many respects this is likely a good thing as one can only imagine the pandemonium of traffic accidents if all unsafe driving habits translated directly to an accident. On the other hand, if risky behavior such as taking short-cuts produced rewards including increased productivity, leisure-time or control and extinguishment of wildfires, they can become entrenched as habit or even Standard Operating Procedures (SOP's).

Geller (1996:42 – 43) explains learned risk-taking using a learning activity that most people can relate to. When first learning to drive a motor vehicle, we were understandably nervous and very cautious. Because this was a new experience it commanded our complete attention. Human nature in this instance was on the safe side.

As our experience increased and many of the skills necessary to operate a motor vehicle became somewhat instinctive, our precautionary behavior likely began to diminish. We were more likely to drive with only one hand on the steering wheel, carry on a conversation with passengers, smoke, change lanes without signaling or even snack and drink. There have been reports in North America of people being cited in a single incident for speeding and changing lanes without signaling while talking on a cellular telephone and smoking.

Geller explains further that these risky behaviors propagate because we perceive them as being trendy, convenient, or they save us time. As such these risky behaviors provide us with a reward, while only occasionally are they punished by an accident.

There are many instances in the wildland fire business where activities that might be considered as risky have produced fire control rewards with few punishments. Such activities as hot-spotting unanchored firelines, deploying from helispots upslope of the fire because the brush was less dense and it would require less clearing, or forgoing a detailed size-up in favor of quick engagement.

But these successes and rewards are not coming in the face of day after day exposure to extreme fire behaviour. They are occurring in what is the majority of occasions of normal or average fire behaviour conditions. Fire behaviour conditions over which fire suppression technology has developed a position of superiority over nature. It is under this majority of fire behaviour conditions where firefighters develop what Weick (1995) refers to as “over-learned behaviour” and where the fire suppression culture and the can do attitude is formed.

While the author hasn't conducted a detailed study of all wildland fire agencies, there appears to be an inverse relationship between the percent number of fire season days of extreme fire danger and percent initial attack success. But it is the extreme fire danger conditions that occur a relatively small percentage of the time that will account for the majority of area

burned. It is also these conditions that contribute to the majority of entrapment related near-hits, injuries and fatalities.

Aggressive initial attack

In spite of the negative impacts of strict fire control on fire dependant ecosystems and escalating fuel hazards, it is still the dominant practice in much of the extensively managed forested/bush areas. The challenge of controlling all fires by 1000 hours of the day following discovery was introduced to North America in 1935 as 10 A.M. Fire Control (Pyne 1982). While some agencies have modified this rule with additional criteria such as control size objectives, it has remained substantively unchanged in its intent and application. The need to fight wildland fires aggressively was clearly important as the original 10 Standard Fire Orders (USDA 1957) were edited to include the statement "Fight fire aggressively but provide for safety first". From that time onwards, aggressive fire suppression has been linked with firefighter safety, the suitability of which has come under some debate.

Aggressive initial attack has become a defining character of wildland fire suppression agencies around the world, and for good reason. Over the years it has produced astonishing results in the pursuit of fire control goals and objectives. While the criteria for what constitutes a successful initial attack varies somewhat amongst agencies the overall results have been exemplary. Influenced extensively by land management practices and related fire regimes, initial attack success generally exceeds 90%, with some agencies operating in the high 90% ranges. The results speak for themselves as few enterprises or industries can boast such an accomplishment. Clearly, if some aggressive fire fighting was good, then more must be better and a lot must surely be better yet. It was applied as a one-size-fits-all solution to what has proven to be a more complex ecosystem challenge.

Fire control rewards and punishments

Rewards in the wildland fire business are many and may be intrinsic or extrinsic. The scope of this discussion is specific to the various initial attack rewards and punishments and how they might influence the safe or unsafe character of the wildland fire culture.

The rewards of aggressive initial attack to fire control practices as previously described are obvious, at least in the short-term. It is evident in every aspect of agency fire control operations, from the recruitment and training of staff, to daily preparedness planning and incident tactics.

On the other hand there are relatively few punishments when one considers the number of firefighter assignments that occur globally during a single year. The vast majority of fires are controlled as per policy with relatively few accidents or near-hits. Further influencing this is the prospect of near-hits going un-recognized or even providing a reward in itself.

Braun (1995) defines a near-hit from a behavioral perspective as an accident without the consequences. To individuals who thrive on the "adrenaline rush", a near-hit may go un-recognized as a punishment and could actually be valued as an exhilaration reward. What person in the wildland fire business has not observed the rise and fall of firefighter interest and enthusiasm as a direct response to fire danger? As Hart (1995) explains it, "getting away with it" reinforces the attitude that firefighters can do the job with an ever-diminishing margin for error. In this respect, getting away with it effectively raises the bar on risky

behavior. In combination with the adrenaline rush, getting away with it can become the subject of fire control folklore, effectively undermining the safety first objective.

Standard operating procedures

What evolves from such reward and punishment relationships is a set of expressed and implied "Standard Operating Procedures" (SOP's). Expressed SOP's can come in the form of written and agency sanctioned policies, procedures, orders, watchouts, guidelines and other such proclamations. Implied SOP's are extremely influential in that they are entrenched in the culture itself as witnessed by such remarks as "we've always done it this way". Hampton (1986) describes expressed policy as frequently proclaiming lofty and admirable intent while implied policy exists in established activities and does not necessarily comply. A suitable example of this in the wildland fire business is the ongoing debate over the 10 & 18. While management claims, "we don't bend them, we don't break them", firefighters are steadfast that you couldn't fight a fire without at least bending the rules.

It is likely that the firefighter's position would be most accurate because they should know best how they are conducting themselves on the fireline. In support of the firefighter there could be times when the orders themselves may be contradictory. Arguments can be made that the order "Fight fire aggressively but provide for safety first" is in itself restrictive if not outright contradictory.

The current structure of the 10 Standard Fire Orders lists first, "Fight fire aggressively but provide for safety first". They were arranged in this manner to produce the easy to remember acronym FIRE ORDERS, not necessarily as a hierarchy of application. Nonetheless, the perception of a hierarchical structure is unavoidable. This would imply that there is no other option available to the firefighter but aggressive fire suppression. As previously described, aggressive fire suppression is quite acceptable as a safe and effective strategy for the majority of fire environment conditions that the firefighter is likely to experience. But as a one-size-fits-all approach to a very dynamic and complex work environment, across the spectrum of fire behaviour conditions is far too simplistic.

There are times when the fire environment will dictate that aggressive fire suppression is simply high risk and low reward (Beaver 2001). Under extreme conditions "Safety First" may require a less aggressive and more conservative strategy. During such times there is not only a conflict within this order itself, it is also in conflict with the order "Initiate all action based on current and expected fire behavior". To base ones actions on current and predicted conditions of extreme fire behavior could require tactics of utmost caution and even non-engagement. Less aggressive tactics or non-engagement is not possible however, through a literal interpretation of the 10 and 18. Nor is it an over-learned behavior.

Tactically, there appears to be little variation between agency's SOP's when it comes to initial attack. Aggressive, direct attack (least size, least damage, least cost) with power pumps and hose, engines, line construction and hot-spotting or some combination of these is generally the status quo. Heavy equipment, air tankers and helicopters with buckets will frequently provide support in periods of higher fire danger.

There also appears to be little inclination to venture outside of this comfort zone when the fire environment conditions escalate to such levels where traditional fire suppression is unlikely to deliver the traditional results/rewards. Witness pre-suppression planning that prescribes

increased initial attack resources with more aggressive dispatch rules. Or consider initial attack operations where a fire has failed to respond to the traditional tactics but the contingency simply calls for more of the same resources applied more aggressively.

Perceptions and expectations

The perception that all wildland fires can and should be controlled is greatly influenced by the huge success agencies have had in doing just that. Fire control propaganda in itself has its basis in the overall success that agencies have had in controlling wildland fires.

Providing the fire environment cooperates (which it does on the majority of occasions) the public witnesses teams of professional firefighters quickly and efficiently controlling and extinguishing wildland fires with minimal burned area or related damage. During these times all is well and fire control agencies are revered as highly skilled professionals providing their mandated service as expected. It further serves to reinforce the over-learned belief and expectation in aggressive fire suppression.

Witness an entirely different scenario when nature does not cooperate, which in consideration of today's fire suppression technology represents a relatively small number of occasions. It is during such occasions that the public can and does exert a great deal of pressure on fire control agencies largely through the media and political avenues. The South Canyon Fire was initially classified as a low priority fire and actioned only after public concerns were expressed (South Canyon Fire Investigation 1994).

Perceptions and expectations do not end with the public. Gleason (1994) recounts an experience as a firefighter on the 1966 Loop Fire. His crew superintendent, Chuck Hartley refused a dangerous assignment cutting fireline downhill in a chimney. As history reveals his assessment of the situation and judgment was correct. Twelve firefighters of the El Cariso Hotshots who accepted the assignment were killed when the fire blew-up as Hartley had earlier assessed. His behavior had been formed at least in part by witnessing first hand the ultimate wildland fire punishment. As a firefighter Hartley had been at the 1956 Inaja Fire that had killed 11 firefighters under remarkably similar conditions.

Gleason (1994:23) speaks further about "the Can Do Attitude and sense of ability and invincibility" which prevailed in the El Cariso crew and how it influenced their decision. This attitude did not mystically appear when they got to the Loop fire. It had formed years before through experiences of risk and reward or punishment.

The behaviors demonstrated at the Loop Fire provide a good example of the fallacy of common sense risk management. "it's just common sense" is a phrase that can be heard only too frequently in all aspects of the wildland fire business. Its failing is that common sense is not common, it is specific to each individual. Harley's attitude and behavior was influenced by a different set of rewards and punishments than that of the El Cariso crew.

Taking this a step further Johns (1996) reports about the legal arguments presented at the Dude Fire litigation about the great amount of discretion that the 10 & 18 permit. There is no objective standard against which to measure the risk and the propriety of the action. This leaves the interpretation of how much risk is too much to the individual's specific sense. Specific sense being the product of individual risk and reward or punishment experiences, of which no two people share exactly the same set of experiences.

Defining Success

The manner in which a business or enterprise defines success and failure helps in shaping its corporate culture. It follows the management by objective business strategy that can have adverse side effects if not implemented correctly (Hampton 1986). For instance, if an agency is 90% successful at controlling fires in the initial attack stages does that then mean the other 10% are failures? Is it appropriate to classify a fire that has had all of the elements essential to initial attack success such as early detection and reporting but confronts nature having a better day as a failure?

Control objectives were listed as an influencing factor in both the 1995 Point Fire Accident Investigation (USDI 1995) and the 1994 South Canyon Fire (South Canyon Fire Investigation 1994). For the Point Fire, the Bureau of Land Management, Boise District Fire Management Activity Plan called for the containment of fires at 20 hectares or less. It is believed that this objective influenced the tactics on this fire that was estimated at over 25 hectares upon the arrival of the first crew. All this occurred under a Red Flag Warning and a Haines Index of 6.

The South Canyon Fire Investigation listed similar objectives having contributed significantly to the 14 firefighter fatalities. The Grand Junction District Fire Management Activity Plan called for control of 90% of all fires at 4 hectares or less. Like the Point Fire, the South Canyon Fire fatalities occurred under a Red Flag Warning and a Haines Index of 6.

All too often these are arbitrary criteria, applied with little or no regard to ecological integrity or fire danger realities. As such, these fire control goals and objectives can work to restrict the tactical choices available to the firefighter. The tactics that may be most effective in meeting the agency control objectives may not be the best in terms of firefighter safety. All the same, the firefighter knows only too well what criteria will be used in evaluating success versus failure. Hence the very manner in which we define success and failure in an organization will influence its safe or unsafe culture.

Negative stress

Geller (1996) refers to positive stress versus negative stress and the impacts they have on human performance. He states that some stress is necessary for people to perform, to a point. Too much stress beyond this optimal level however can lead to diminished performance and cognitive failure (Weick 1995). It is also important to note that this optimum level of stress will vary amongst individuals for reasons such as individual training, experience, self-confidence and lifestyle influences.

Typically, the reaction for people experiencing excessive stress is to reduce or manage this stress by falling back on familiar and over-learned behavior (Comfort Zone). A negative stress producing condition associated with initial attack or extended initial attack could occur when the fire's behavior escalates past the capabilities of traditional initial attack methods. As conditions deteriorate, the regression to over-learned behaviour favours aggressive fire suppression over fire abandonment. But it is the failure of this over-learned behavior in the face of extreme fire environment conditions that has contributed to the negative stress in the first place. The firefighters get caught up in an ever-deteriorating vortex.

Weick (1995) describes the situation on the South Canyon Fire where the demands exceeded control capabilities as the fire behavior and fire complexity escalated, resulting in a regression to over-learned behaviour. In the case of the South Canyon Fire the over-learned behavior was a cutting fireline. At the Thirtymile Fire it was controlling spot fires. All of them familiar activities of aggressive initial attack that had served them well on so many occasions, and had produced so many fire control rewards. In this context, abandoning the fireline or not engaging the fire at all would not have register as an over-learned or familiar behavior.

Conclusion

Wildland fire has been described a phenomena of nature not unlike hurricanes, earthquakes and floods. However, unlike these other natural phenomena humankind has been able to, within limits, control wildland fire. It is this ability to control wildland fires under relatively common fire environment conditions that produces the fire control rewards that agencies hold in such high regard. This has not come without a price however. The manner in which agencies define and reward, success and failure has a major influence on the attitudes and behaviors of its employees and hence its safe or unsafe business culture.

Traditional methods of aggressive fire suppression have produced astounding fire control rewards over the decades, and for the majority of fire environment conditions aggressive fire suppression and “can do” are both safe and effective. But as the fire environment escalates to extreme fire behavior levels the risk to firefighter safety increases accordingly while fire control effectiveness (rewards) diminishes. Because of this relationship, aggressive fire suppression can oscillate between an activity of low risk and high reward and one of high risk and low reward according to conditions of the fire environment.

As fire managers have largely no control over the fire environment it is the human factors influencing the acceptance of hazardous and risky behavior that will need to be managed. There is a need to recognize when aggressive fire suppression and “can do” will save lives and control fires and when it will not. While “can do” can be an admirable quality, if it is not tempered by a healthy dose of reality it can, and has had, disastrous consequences.

The wildland fire community, politicians, and the public will have to correct their perceptions and expectations regarding the realities of wildland fire versus fire suppression technology. Aggressive fire suppression would not represent the unquestionable, solitary solution to the wildland fire problem. Fire suppression tactics would be applied consistent with the prevailing conditions of the fire environment, probability of mission success, and the values at risk. It could mean total aggressive fire suppression, more conservative tactics or complete non-engagement.

This could well translate to fewer fires fought, reduced initial attack success rates, increased area burned, with fewer accidents. We must ask ourselves if we have the determination, conviction and most of all, the courage to attempt such a cultural change.

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