Behavioral Adapt

Why "Safety" Features Don't Always I

Following an accident, there is often a contention that if only the product, process or apparatus had been designed differently, the accident in question would not have occurred. While superficially attractive, such a perspective is simplistic at best. In many (if not most) cases, the design of a product influences the way individuals interact with it, as well as the way that they perceive the product and the level of risk associated with it. Safety interventions introduced into a system often produce secondary effects (behavioral adaptations). Individuals often react to perceived safety enhancements in a compensatory fashion and adopt riskier behaviors based on the perception that the environment has become safer. Unfortunately, the perceptions of increased safety due to a design change may not match reality. Such perceptions may lead to behavioral changes that result in a net *decrease* in overall safety.

A simple example of this concept is the behavior of many operators of four-wheel drive vehicles during the winter. When the roads become icy or slippery, the majority of vehicle operators reduce their speed. It is not unusual, however, to see operators of four-wheel drive vehicles simply engage the higher traction system rather than slowing down. Their perception appears to be that with four-wheel drive, their vehicles are protected from the affects of reduced traction and that a decrease in speed is unnecessary. While this may be true to some extent regarding their ability to *go*, it ignores the fact that their ability to stop or turn on such surfaces is largely unaffected by the presence of the system. More accidents than would otherwise be likely seem to occur in such scenarios. Had the four-wheel drive operators reduced speed, as did their two-wheel drive counterparts, they would have experienced a net increase in overall safety. However, their behavioral change negated many of the positive benefits of the system.

Other examples from published literature include evidence that:

- For every foot a road lane is widened, speed on the roadway increases by an average of 2 mph.
- Shoulder widening/paving is associated with decreases in crashes, and also with increases in road speed—the net result is that paved shoulders are only marginally safer than unpaved ones.
- Painted lane edges are associated with decreases in accidents on lighted roadways, but with 10% increases in vehicle travel speeds in low/no-light situations.
- And similar to the auto scene, use of personal

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ıcrease Safety

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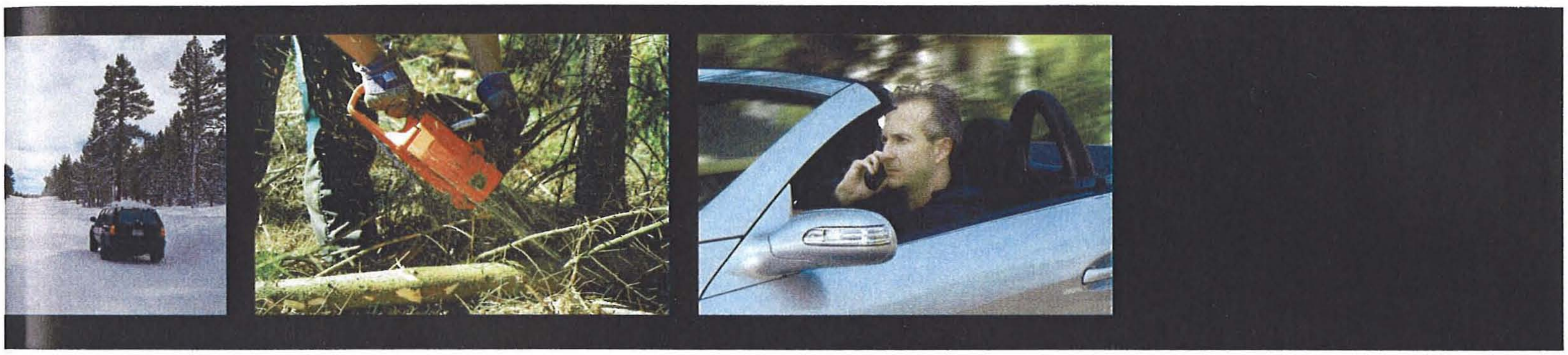
QUICK LOOK

- Despite the best efforts of designers and engineers, accidents using both consumer and commercial products often occur.
- Added safety features in many cases do not eliminate these accidents due to changes in user behavior.
- Behavioral changes in many cases may result in a reduction of overall safety.



protective equipment by loggers results in a decrease in injuries to the protected portions of the body, but an increased injury rate to parts of body that are unprotected due to increased risk taking.

Research has postulated three different types of negative behavioral adaptation potentially associated with safety features introduced into a product. These include: 1) *misuse as a control system* (e.g., hitting the safety edge of an elevator door to stop the door from closing); 2) *misuse in kind* (e.g., putting safety devices to uses that are the opposite of what was originally intended); and 3) *misuse in magnitude* (e.g., operating a system or device beyond its rated performance because the operator knows that a safety factor is built in). Any of these three types of adaptation may result in reducing or eliminating the benefits produced by a safety augmentation.

One potential reason for behavioral adaptation is the concept of ***risk homeostasis***. In general, an individual subjectively compares the risk associated with any particular task to the benefits derived from undertaking the activity. Individuals then guide their behavior based on the balance between the two. If the level of risk associated with an activity is assessed as being greater than an individual's acceptable level, greater levels of caution are exhibited. However, the flip-side of this is also true; if the level of risk is assessed as less than that considered acceptable, individuals may increase their risk-taking as long as there is perceived benefit in doing so. Individuals tend to regulate their behavior to maintain a homeostasis (balance) between risk-exposure and risk-avoidance at what they perceive as an acceptable level.

A critical issue is that the risk-exposure level is subjectively, not objectively, determined and may change depending on time or circumstances. Consider the example of drivers who normally drive 5 to 10 mph or more over the speed limit (don't we all?). The drivers benefit from decreased travel time, while risking a ticket, an accident or an injury to themselves or others. The subjective perception of risk associated with this action decreases the longer the driver does not experience negative consequence, and speed may further increase the longer the negative consequence is avoided. If the driver eventually does experience the negative outcome (e.g., a ticket), his subjective assessment of the potential likelihood of that event increases, normally resulting in a reversion to the speed limit (for at least some period of time.) Objectively, the risk associated with speeding has not changed over time, though the driver's assessment of it has, and a change in risk-taking behavior has resulted. The same process occurs with other circumstances and products as well.

The concept of behavioral adaptation can be used to evaluate traffic regulations in an attempt to predict their outcome on traffic safety. For example, many municipalities are enacting legislation requiring drivers to utilize "hands-free" kits while using cellular telephones when behind the wheel. Almost all researchers agree that the use of cellular telephones while driving has some negative impact on reaction time to unexpected events (though they often differ with regard to its degree or relative importance.) Researchers also agree that the critical element impacting driver performance with cell phones is the level of mental dissociation from the driving task. While the use of a hands-free kit does allow the driver to maintain both hands on the wheel (how many of us actually drive this way under normal circumstances?), it does nothing to reduce the *cognitive* impact of performing multiple tasks simultaneously. Worse yet, while it is likely that the average driver is aware from media coverage that cell phone use behind the wheel may negatively affect performance, they may not be aware of the nature of the effect (i.e., mental rather than physical.) Potentially, the effect of imposing such a safety measure upon individuals that (unknown to them) does not affect the most important safety aspects of the activity in question, would be an *increase* in the use of cell phones, under the assumption that the safety measure had compensated for the negative consequences of the act. If cell phone use behind the wheel is actually related to an increased probability of accidents, the incorporation of the hands free safety requirement would thus, more likely than not, result in more, rather than fewer, accidents.

Individuals often react to perceived safety enhancements in a compensatory fashion and adopt riskier behaviors based on the perception that the environment has become safer. Unfortunately, the perceptions of increased safety due to a design change may not match reality.

Research supports the likelihood of this type of adaptation. Many drivers are under the impression that antilock brakes result in shorter braking distances for vehicles. This is incorrect; antilock brakes are designed to increase vehicle control during heavy braking by modulating brake pressure. They have either a negative or no effect on stopping distance under normal conditions. Not surprisingly from a behavioral adaptation perspective, at least three different studies (Canada, Denmark and Germany) investigating driver response to antilock brakes have shown that drivers tend to drive faster, follow more closely and brake later in vehicles equipped with the system. In at least one of these studies, the incorporation of antilock brakes was accompanied by an increased, rather than decreased, likelihood of accidents over a multi-year period. In yet another example, studies of the safety benefits derived from mandatory seatbelt laws have shown lower benefits than originally projected by their advocates, largely due to increases in driving speed and reductions in car-following distances.

Nor is this type of adaptation restricted to only the individual actually exposed to the risk. One interesting study involved exposing mothers of school-age children to photographs of potentially risky play activities (e.g., jumping a bicycle various distances off a ramp, using inline skates to ride down hills of varying steepness, climbing a tree various distances to retrieve a kite, etc.), and then asking them what level of risk they would allow their own child to accept with and without safety equipment. Results indicated that mothers would allow their children to accept significantly greater levels of risk-taking when such equipment was used (interestingly, more so for male than female children.) The same comparisons were also performed with the children of the subject mothers; their results also showed an increase in likely risk-taking, but much less than the increase which would have been allowed by the mothers. The results of this study support the view that increases in safety, beyond a particular point, are not necessarily valued by either those exposed to the risk, or by those in charge of the risk takers.

In short, while potentially laudable in concept, the incorporation of safety-related design changes is not always valued by product users, nor does their incorporation always result in a reduction of injuries to those using the product. In many cases, changes in user behavior will have an ameliorating effect on the overall outcome. If the user is aware of the modification, behavioral adaptation may result in changes in the way the product is both perceived and used. Such adaptations may result in either reducing the positive benefits of change or even producing a negative impact on overall product safety. **cA**

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