

UNSAFE ATTITUDES AND ACTS – A PSYCHOLOGICAL EXPLANATION

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INTRODUCTION

At the 1997 Queensland Industry Mining Health & Safety Conference, it was argued:

“Industry initiatives to improve safety performance in mines will largely depend upon changing many of the attitudes and behaviours that make up the mine culture and codes, which in turn influence the way in which mineworkers perform their daily work”.

The importance of changing safety behaviour as a means of improving safety performance is well understood by the mining industry. The concepts of safety “attitudes” and safety “culture” are less well understood. Improving understanding may prove an important milestone for the mining industry to increase its focus on targeting these factors in its endeavour to improve safety performance. And unless such concepts are clearly understood, it is unlikely the industry will invest the necessary time, effort and money in an attempt to change them.

The objectives of this paper are two-fold:

Firstly, to explain the aetiology, maintenance and management of unsafe attitudes, acts and culture using scientifically-established psychological principles

Secondly, to argue that unsafe attitudes and unsafe acts form part of a long chain of antecedent causal events which could lead to incidents higher up the safety ladder ranging from near misses and LTI’s through to fatalities.

Accidents have been investigated according to two principal approaches:

“Theory A” Accidents are caused by unsafe behaviour and that certain people are more prone to behave unsafely than others. According to this approach, accidents can be prevented by changing the ways in which people behave.

“Theory B” Accidents are caused by unsafe systems of work. According to this approach, accidents can be prevented by re-designing the systems of work.

The systems approach to accident prevention has significantly reduced the number of accidents. According to Margolis (1973), engineering solutions to accidents are in themselves, insufficient in the prevention of accidents. Companies have in general invested:

- Large sums of money in re-designing their systems to “engineer out” safety hazards and risk wherever possible.
- Enormous resources in developing “Job Safe Procedures”.

Yet despite the investment of money and resources, the incidence of fatalities remains relatively unchanged and governments, companies, employees and the marketplace all agree they continue to be “unacceptably high”. Galvin (1998) reported that, *“A new technology produces more tonnes with less people, but introduces different types of hazards, and the probability of being killed underground has not come down dramatically”.*

Remote-controlled equipment for example, was designed and introduced into the coal and metalliferous mining industries to reduce the risk of injury to employees working in underground conditions deemed to be unsafe. The objective of the systems approach was to improve safety by moving the operator away from hazardous zones. The reality is that the very introduction of remote controlled equipment has itself caused an alarming number of operator injuries and fatalities.

Hopkins (1995) reported: *“Both government safety organisations and unions are quite simplistic on safety. They focus on equipment, not on the acts of people. In our experience, 95% of accidents occur because of the acts of people. They do something they are not supposed to do and are trained not to do, but do it anyway. “Changing this behaviour is much harder than focussing on equipment” (pp 187-188).* RTA (1995) statistics similarly argue that 95% of crashes involve human error.

Coyle (1995) reported *“that unsafe attitudes almost*

always precede accidents” and that “very little work has been undertaken to systematically measure expectations and attitudes towards occupational health and safety at various levels of organisations”.

Coyle is critical on the pre-occupation with the current statistical measures and states: “*Safety climate, the objective measurement of attitudes and perceptions toward Occupational Health & Safety issues, has been largely ignored and measures such as lost time and frequency rate have been used to determine the efficacy of Occupational Health & Safety Programmes*”.

SAFETY BEHAVIOUR

Psychology, the “scientific analysis of behaviour” has established that almost all human behaviour is learned. The principles that govern the acquisition, maintenance, modification and control of learned behaviour are well understood. Safe and unsafe behaviour - including the failure to learn appropriate safe behaviour i.e. a behavioural deficit, are subject to the same laws and principles that govern all other human behaviour and function in accordance with the principles of classical, respondent and operant conditioning or variants thereof. According to this approach, attitudes are viewed as habits which are learned in exactly the same way as all other stimuli and response bonds are established and are maintained by the same reinforcement contingencies. However, attitudes differ in that they cannot be observed directly.

Behaviour is subject to lawful causality. The nature of the causal relationship implies that behaviour is inherently predictable, i.e. under these conditions the likely outcome is this:

CAUSE [Stimulus] ----> EFFECT [Response]

By studying past safety behaviour (safe and unsafe) we can establish the causal relationships with which to predict future safety performance. If we can predict the future occurrence of behaviour, then surely we can attempt to bring it under control in order to prevent or minimise its future occurrence.

The Behaviour Modification approach is concerned with the acquisition, maintenance and modification of behaviour through the application of empirically-established psychological principles. The objective of behaviour modification is to increase or decrease the probability of the future occurrence of target behaviours in a structured and systematic way. Abnormal or inappropriate behaviour including unsafe behaviour and unsafe attitudes, is not regarded as distinct from normal behaviour in how it develops

and is maintained and can therefore be re-engineered through the application of Behaviour Modification Principles.

Specifically a behaviour modifier objectively analyses the interaction of the individual and the environment - including both internal and external events, to identify and catalogue the antecedent and consequent unsafe attitudes and behaviours, the conditions/circumstances under which they occur (and do not occur), and the reinforcement contingencies that maintain each of them; in order to design and put in place strategies to manage the target behaviours. Compliance and maintenance of the desired attitudes and behaviours from part of the behaviour modification programme.

SAFETY CULTURE

Safety culture is the sum total of learned patterns of safety behaviour, attitudes, values and beliefs shared by a group of people. “Group” may represent the mining industry, a specific minesite or a discrete section of a mine. For example, it is not uncommon to find that different sections of a mine or different shifts have different cultures.

SAFETY ATTITUDES

Attitudes are a major determinant of human behaviour. Attitudes shape and influence behaviour so that people respond in a relatively consistent and integrated fashion in a wide variety of conditions, situations and circumstances. Consequently, any changes brought about in the attitudinal domain is likely to have an important effect on safety behaviour. The fact that attitudes exert a strong influence on behaviour makes them an important factor to focus on in improving mine safety performance.

Psychologists have traditionally made a distinction between three components of attitudes:

- Cognitive component consists of the individual’s ideas - thoughts, perceptions, beliefs etc. in relation to an event, object, individual, condition or situation.
- Affective component comprises the person’s feelings towards an event, object, individual, condition or situation. This emotional aspect of attitude is frequently the most deep-rooted component and the most resistant to change.
- Behavioural component represents the predisposition or tendency to act in a certain way

and consists of the observable behaviour displayed by the individual towards an event, object, individual, condition or situation.

The complexity and strength of the respective components have significant implications for the successful development and modification of safety attitudes.

Despite the recognised importance of attitudes in influencing behaviour, changing safety attitudes directly in a structured and systematic way has not played a major primary role in mine safety programmes. This may be attributable to a number of factors:

First, attitudes are not directly observable and as a result require different technology to objectively, validly and reliably identify, observe and measure them. By contrast, **overt behaviour** is public and mine safety improvement programmes have been able to readily observe, record and measure safe and unsafe behaviour on the minesite.

Second, compliance can be somewhat readily monitored against rules and regulations - if the behaviour is public. The problem of monitoring attitudinal compliance is far more complex and requires a different set of skills and level of expertise that is unlikely to have formed part of the university mining engineering curriculum.

Third, attempts to successfully change safety behaviour has proved to be a full-time pre-occupation for the industry on its own without also having to deal with changing attitudes which have their own unique set of problems and many of which are even more resistant to change. Moreover, there are generally many different attitudes which influence a single act of behaviour, and two persons with the **same attitude** toward an object condition or situation, may display quite **different behaviours**.

Fourth, mine safety improvement programmes may have quite correctly, taken the view that changing safety behaviours will also have an indirect impact on changing safety attitudes. The growing body of behaviour modification research evidence indicates that changes in behaviour are accompanied by changes in the attitudinal parameters measured. By contrast, the evidence indicates that changing an attitude may not change the behaviour under consideration and is unlikely to correct skill deficits in the person's repertoire of safety behaviour. We attribute this to the lack of specificity of the change programme and the failure to correctly analyse and target the underlying causes and the supporting reinforcement contingencies.

Elements of mine safety improvement programmes have to an extent attempted to change attitudes, for example through safety posters, notices, bulletins, stickers, and other forms of advertisement. The relative efficacy of these attitudinal change programmes has not been subjected to empirical evaluation. Whilst attempts to change attitudes through "persuasive communication" advertising programmes continues to be a multi-billion dollar industry in the marketplace, the volume of experimental research which has emerged since the 1930's, reveals there is little evidence any changes in attitude that may be brought about by persuasive communication, results in consequent observable changes in behaviour. This would suggest that spending the safety dollar on such subtle forms of persuasive communication, may be better spent on more direct forms of intervention on changing safety attitudes.

An important complicating problem for the change agent is that attitudes sometimes appear to be unrelated to the behaviour actually displayed. This is attributed to the influence of certain factors which prevent individuals from acting in a manner consistent with their true feelings and beliefs. For example, a mineworker may feel and firmly believe that contrary to the company's training programmes and job safe procedures, performing a task in a certain way is "safe" but will adhere to the set procedures in the presence of a supervisor. However, once the supervisor is no longer around, the mineworker may revert to performing the task according to his beliefs.

PSYCHOLOGICAL ANALYSIS OF SAFETY BEHAVIOUR & ATTITUDES

Behaviour does not occur in isolation but is situationally determined. Behaviour is elicited or emitted and controlled by the environment in which the individual operates. Behaviour is controlled through its antecedents as well as its consequences and is maintained by the nature of the reinforcement contingencies which operate in the environment. The consequences of behaviour increase or decrease its future probability of occurrence - depending upon whether they are positive or adverse. Attitudes are similarly formed and controlled by the same reinforcement contingencies that form and control behaviour.

Figure 1 (at attachment 1) shows the application of the Stimulus-Response model to explain the relationship between the antecedent events [S₁], the behaviours emitted [R₁] and the reinforcers which maintain the behaviour. A range of antecedent causal

events is presented which can act as trigger stimuli. These include Behaviours 1 to 3, Attitudes A to C and Reinforcers X to Z. The range of resultant consequences which can be emitted include Behaviours 4 to 7 and Attitudes D to F, and these are maintained by Reinforcers 1 to 6. The illustration shows that one or more events can act together to result in one or more responses which are maintained by one or multiple reinforcers. Note that Behaviours 4 to 5 and Attitudes D and E form part of a chain and act as stimuli which in turn result in Responses R2 to R5.

Effect of consequences

Behaviour which leads to positive consequences is likely to increase in the probability of its future occurrence. Similarly, an attitude which leads to positive consequences or no adverse consequences, is likely to be reinforced or strengthened. In general, behaviours which result in adverse or punishing consequences are likely to be suppressed in the circumstances under which they occur, or they may decrease and even extinguish.

There are two types of reinforcement - positive and negative. Positive reinforcement refers to an increase in the frequency of a response (e.g. a behaviour or an attitude) that is followed by reward. Negative reinforcement refers to the increase in frequency or strengthening of a response following removal of an aversive stimulus or event, immediately after the event occurs. For example, an operator placing comfortable ear muffs over one's ears in the presence of a noisy mill or CHPP plant (aversive stimulus), reduces the intensity of the aversive stimulus and the act of placing the ear muffs over the ears is reinforced. In other words, negative reinforcers are those stimuli which strengthen behaviour or attitudes when they are "removed" or brought under control. Negative reinforcement and punishment are often confused. In punishment, the effect of the aversive stimulus is to depress the behaviour or attitude when it is presented - not strengthen it. Punishment refers to the presentation of an aversive stimulus after a response that depresses or decreases the probability of that response. Removal of positive reinforcers after a response also act as punishment.

Effect of Antecedents

Antecedent events also influence the occurrence of safe and unsafe acts and attitudes. Antecedent events attain an influencing role over behaviour through their association with reinforcing events and can act as stimuli which "trigger" the unsafe act. Antecedent events which facilitate the occurrence of behaviour are generally referred to as "discriminative" stimuli.

A discrimination is established by selectively reinforcing a behaviour in one situation and not in another by means of "differential" reinforcement according to one of the many "schedules of reinforcement". In general the more intermittent the reinforcement schedule, the more resistant the behaviour is to extinction. A primary objective of safety inductions and training programs is to form the "right" discriminations which generate a range of appropriate safety attitudes and safe acts or work behaviours. In behaviour modification, systematic re-arrangement of the antecedent events to cause behavioural and attitudinal change is referred to as "stimulus control".

Continued non-reinforcement can result in "extinction" of a behaviour. Depending upon the nature of the reinforcement history, the behaviour or attitude may prove to be resistant to extinction and may on occasions be subject to "spontaneous recovery".

The psychological principle of reinforcement states "behaviour rewarded is behaviour repeated". If for example, a mineworker commits an unsafe act and no adverse consequences follow, the unsafe act is unwittingly rewarded, i.e. the act of committing an unsafe act is reinforced. Reinforcement by its very nature strengthens the behaviour and consequently the probability of the future occurrence of committing the unsafe act is increased. If a remote controlled equipment operator, contrary to training and operating procedures, knowingly commits the unsafe act of entering a hazardous "no go" area and there are no adverse consequences, the unsafe act by its very nature is reinforced i.e. rewarded. As a result, the remote controlled equipment operator is likely to repeat the unsafe act of entering the no go area - irrespective of the previous training received.

Each discrete attitude, act or "piece" of behaviour is part of a "chain" or "sequence" involving various behaviours - antecedents and consequences. Not only is the unsafe act rewarded, but so are some or all of the antecedent events which preceded the act. As a result, many or all of the associated antecedent events are also reinforced. These may include "attitudes" ("thoughts", "perceptions", "beliefs", "ideas", "feelings"), as well as any other behaviours which form part of the antecedent chain. Where discrepancies exist between the person's behaviour and attitudes, over time these will be corrected until a relatively "congruent" relationship is generated between the person's behaviour and the attitude(s) held.

Figure 2 (at attachment 2) shows the application of the Stimulus-Response model to explain the

relationship between unsafe attitudes and acts and their consequences. The range of antecedent causal events which can act as trigger stimuli includes a large mixture of safe and unsafe behaviours as well as safe and unsafe attitudes. The model also shows the combination of safe and unsafe attitudes and behaviours which form part of an individual's repertoire. Depending upon the circumstances, the resultant consequences can range from "no adverse consequences" through to statistically low probability events such as a near hit, property accident damage, LTI and even a fatality. Except in the case of the fatality, each consequence can as part of a chain, in turn act as a further stimulus for the individual.

If the above remote controlled equipment operator continues to commit such unsafe acts and they go unchecked, they progressively become part of the person's behavioural and attitudinal repertoire and over a period of time, form part of the person's belief system. Such "experienced" persons may serve as role "models" for new recruits and even with employees of long standing. Through the process of "vicarious" or "observational" learning, the trainee, bystander or employee learns work procedures from the "model" which may include safe as well as unsafe ones.

The coexistence of a mixture of safe and unsafe behaviours and attitudes in a workplace can also be generated in other ways - often in accordance with the principle, "where there are no rules people develop their own". In workplaces where there is an absence of safe work procedures, or existing ones suffer deficiencies, or in the absence of adequate training, people take the initiative and develop their own work procedures - some safe and some unsafe. Over time, a combination of safe and unsafe attitudes, behaviours, practices and belief systems are established in the workplace. Once established, they become the "norm" and represent the "acceptable safety standards" and provide the "boundaries" within which one carries out their duties on the mine site. Eventually they form part of the "corporate safety culture" on "how things are done around here". The objective of the "safety diagnosis" is to identify and quantify precisely what is the corporate safety culture. Once identified, then and only then can we design and introduce the most appropriate intervention strategies and programmes (Jonson 1982, 1986, 1997). To do otherwise, we may be band-aiding symptoms without addressing the right underlying causes.

Punishment refers to a situation where the operator of the remote-controlled equipment is suspended by the supervisor after being caught engaging in the unsafe act of entering the designated hazardous no go area

even though the operator had been trained and instructed not to do so. The effects of punishment are complex, and often do "seem" not to produce the desired safe behaviour and attitude. In certain circumstances the aversive stimulus will permanently eliminate the undesirable behaviour after one exposure whilst in other circumstances, punishment will only suppress the emission of behaviour in the presence of the aversive stimulus. If for example, the remote controlled equipment operator notes that he is being observed by his supervisor, the operator is unlikely to enter the no go area under these circumstances. Once the supervisor departs from the situation, the operator may sooner or later revert and continue to proceed with engaging in the unsafe act of entering the no go area. Under these circumstances, the presence of the supervisor acts as an aversive stimulus which temporarily suppresses the emission of the unsafe conduct - but does not eliminate it. For reasons such as this, punishment as of means of "control" should be used with caution.

Failure to learn the appropriate discrimination.

The aetiology of many unsafe acts is through the failure to learn the appropriate discrimination, or through the formation of incorrect, inadequate or inappropriate discriminations. This may be due to the nature of the safety induction training, or the inadequacy of on-going training, or the inability of the individual to grasp the complexity of the concepts involved in safe working procedures - or a combination of all of these. Irrespective of the cause of the failure of the individual to learn the appropriate discrimination, the person is classified as having a safety skill deficit. Correction may involve focussed discrimination learning using selective reinforcement schedules during training or refresher training, and may also require job or systems re-design.

UNSAFE ATTITUDES AND ACTS

It is argued that unsafe attitudes and acts are the causal precursors to and from part of a long chain of antecedent causal events which could lead to incidents higher up the safety ladder ranging from near misses and LTI's through to fatalities. As such, unsafe acts and attitudes must be treated just as seriously as LTI's and fatalities.

The focus of the mining industry and the marketplace in general, has largely been on LTI's as a measure of safety performance. The focus has resulted in a progressive reduction in LTI's over the years. This is consistent with the principle - "what gets measured gets managed". What is now needed is for the industry to apply the same disciplined focus

and approach to the management of unsafe attitudes and acts in the workplace.

An overview of the research literature reveals that the frequency of unsafe acts has not been subjected to quantitative empirical research. Anecdotal evidence suggests they occur many 100's if not 1000's of times before a more serious event occurs. Such

anecdotal evidence is generally based on people's observations, perceptions and/or beliefs.

The position of unsafe acts and attitudes in the safety hierarchy is illustrated by extrapolating from the well-documented 1969 "Accident Ratio Study" (or "Safety Triangle") which reported:

ACCIDENT RATIO TRIANGLE	
1	SERIOUS OR DISABLING INJURY
10	MINOR INJURIES
30	PROPERTY DAMAGE ACCIDENTS
600	INCIDENTS WITH NO VISIBLE INJURY OR DAMAGE

If we were to incorporate the unsafe acts and attitudes into the Safety triangle using the 1995-1996 NSW Underground Coal Industry, which had 6 fatalities and 1158 LTI's i.e. about one fatality in

about 200 LTI's, the hypothesized triangle may well appear as follows:

UNSAFE ATTITUDES & ACTS TRIANGLE N.S.W. Coal 1996	
1	FATALITY
200	LOST TIME INJURIES
600*	PROPERTY DAMAGE ACCIDENTS
2,000*	INCIDENT WITH NO VISIBLE INJURY OR DAMAGE
5,000*	UNSAFE ATTITUDES & ACTS
* Represent hypothesized numbers only	

It should be emphasized that the hypothetical numbers are for illustrative purposes only and are not based upon any empirical research.

The importance for the mining industry is to put in place the systems and procedures to manage unsafe acts in the same way it has effectively managed LTI's. And unless we put the systems in place to identify and deal with unsafe acts, people will continue to perform them as rarely are there immediate consequences for working unsafely.

Earlier it was argued that on each occasion an unsafe act is performed, it is unwittingly rewarded. If the anecdotal evidence is correct or even partially correct, such unsafe acts may be reinforced many 100's if not 1000's of times. Since the unsafe acts are preceded or associated with unsafe attitudes, these are also strengthened. Any associated anxiety which may have been originally present is likely to have long been extinguished. The latency between engaging in unsafe acts and relatively low-probability events such as an incident is in general,

historically so great that all of the interim unsafe behaviours and attitudes become firmly established to form part of the individual's core behaviours and attitudinal structures.

Over time, a complexly-interwoven mixture of safe and unsafe behaviours and attitudes is established and is maintained by the individual's unique reinforcement history. Based on the psychological "principle of reinforcement" and the principle "past behaviour is the best predictor of future performance", and in the absence of consequences or direct intervention, people will continue to engage in unsafe acts and maintain their unsafe attitudes, and the mining industry will continue to suffer loss.

Unless systems are put in place to identify and deal with unsafe attitudes and acts, people will continue to perform them as there are generally no immediate or even short-term consequences. The fact that behaviour is a function of its consequences cannot be over-emphasized. In the absence of deliberate intervention using proven behaviour modification

intervention strategies targeted at modifying and where necessary, introducing consequences for unsafe attitudes and acts, as an industry we are unwittingly rewarding behaviour that has the potential to cause loss-including fatalities. It also has the potential to send the wrong industry signals to the community and politicians.

CONCLUDING COMMENT

Over the past 3 decades, the science of Behaviour Modification has been successfully applied to changing human behaviour and attitudes. The application of the principles of behaviour modification to the management of safety performance in a structured, systematic and disciplined way, particularly for employees working in inherently high risk areas, presents as one of the most promising options for an industry which continues to be plagued with fatalities.

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FIGURE 1
SCHEMATIC PRESENTATION SHOWING RELATIONSHIP BETWEEN ANTECEDENT EVENTS, BEHAVIOURS EMITTED & REINFORCERS WHICH MAINTAIN THE BEHAVIOUR/ATTITUDE

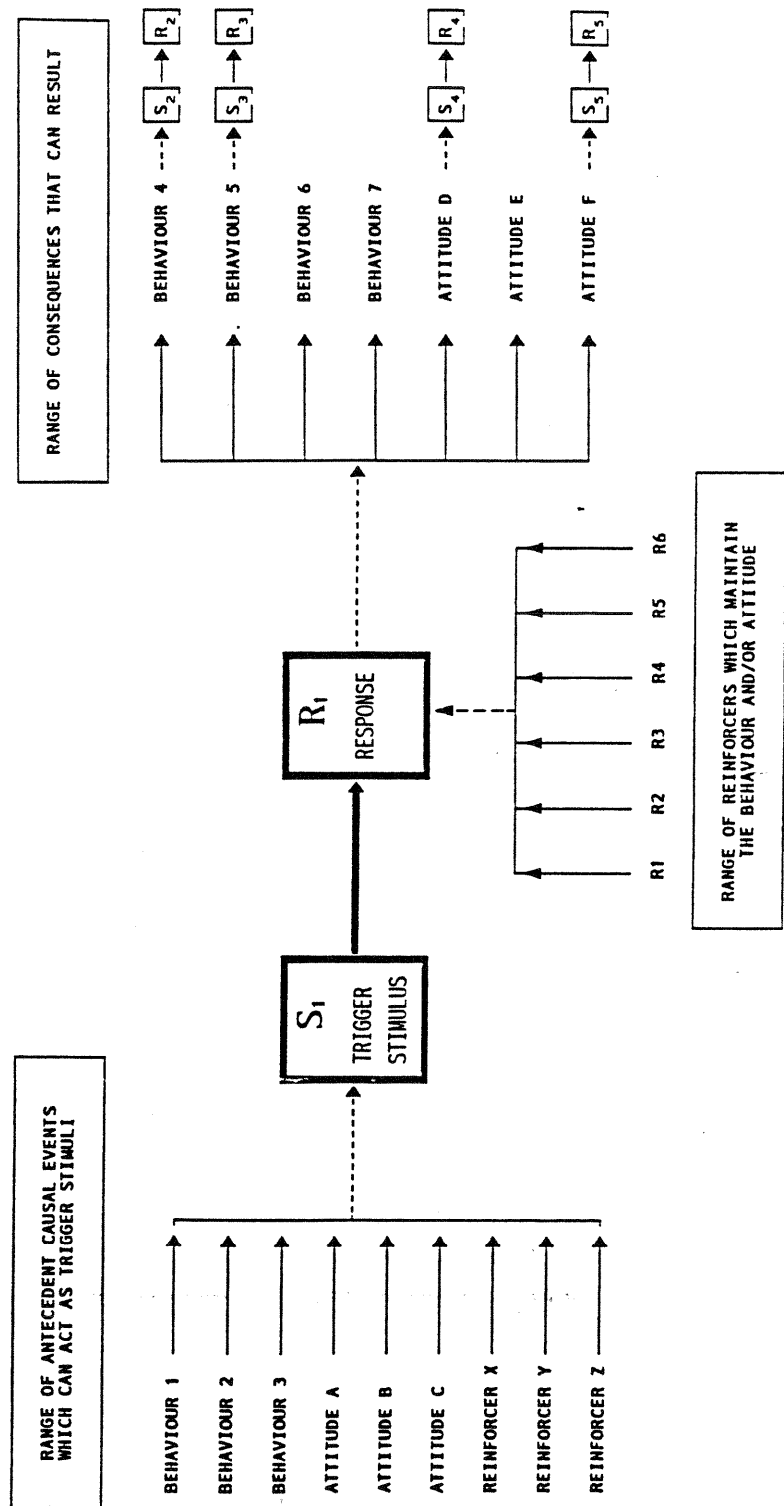


FIGURE 2

SCHEMATIC PRESENTATION SHOWING THE RELATIONSHIP BETWEEN ANTECEDENT UNSAFE ATTITUDES & ACTS, CONSEQUENCES RANGING FROM "NO ADVERSE" THROUGH TO A FATALITY

