“Violence Breeds Violence”:
A Dynamic Systems Approach to Anger and Aggression

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A Brief Introduction

The treatment of emotional disorders, such as anger, depression and anxiety, are commonplace in clinical practices. Despite the prevalence of anger problems (Lachmund and DiGiuseppe, 1997), research has demonstrated that considerably less scientific research has been published regarding this disorder (DiGiuseppe and Tafrate, 2001). Explicitly, spanning the last fifteen years, ten times the amount of research on anger has been undertaken on depression, and seven times the amount has been published on anxiety (Kassinove and Sukhodolsky, 1995). This not only renders a void in the research, but represents a lack of understand regarding both disordered anger and effective treatments for it. In DiGiuseppe and Tafrate’s (2001), the authors compile the findings of previous empirical research regarding anger as a means to develop a comprehensive model for treatment. That notwithstanding, research into disordered anger is not only limited by number (Chemtob et al., 1997), it is also limited by method (Robins and Novaco, 1999). Expressly, the majority of research in this area is based on empirical methods that aim to investigate anger, and treatments, in terms of the open-loop notion of cause-and-effect. It is contested here that this renders a restricted perspective on anger, one that could be developed through utilising closed-loop investigative means. Dynamic Systems Theory is presented as a suitable model for furthering scientific understanding of both anger and aggression (Robins and Novaco, 1999).

Foretaste to Anger, Aggression and Dynamic Systems Theory

Anger

Anger is a frequent affect in the human repertoire of emotions (Scherer and Wallbott, 1994); one that can be defined as “an aroused state of antagonism toward someone or something perceived to be the source of an aversive event” (Novaco, 1998, p13). Although this state is often considered negatively, anger exists in both adaptive and maladaptive forms (Novaco, 1976). Explicitly, anger in its adaptive form can motivate individuals to confront and solve problems. However, anger ceases to be constructive when driven by malevolent goals (Bowlby, 1973). Individuals who are clinically referred with disordered anger demonstrate this latter form of the emotion, which is frequently associated with the negative response of aggression.
Aggression

Aggression can be defined as “spoken or physical behaviour which is threatening or involves harm to someone or something” (Cambridge Dictionary [online]). Although anger does not necessarily elicit aggression, aggression is a product of anger (Chemtob et al., 1997). This relationship is determined by an inhibitory response. Expressly, the impulse to act aggressively is customarily overridden by inhibitory devices. However, should disinhibitory factors be present, this quotidian control mechanism becomes nullified (Bandura, 1973).

Dynamic Systems Theory

The term ‘system’ can refer to any organised assemblage whose composing elements are so intertwined that they operate as a unitised whole (von Bertalanffy, 1968). As such, humans themselves can be considered an example of a system. Dynamic Systems Theory (DST) is a branch of Cybernetics; a term coined by Wiener as the science of “control and communication in the animal and machine” (Wiener, 1948, p1). According to Dynamic Systems Theory the behaviour of a dynamical system, or a system that changes with time, may be understood through the application of a number of mathematical principles (Granic and Patterson, 2006; Vallacher and Nowak, 1997). DST utilises terms such as feedback loops, state space diagrams, attractors, bifurcations, catastrophes, and chaos to explain how the behaviour of dynamical systems can become self-regulated (Granic and Patterson, 2006; von Bertalanffy, 1968). Nowak and Colleagues (Nowak et al., 2005) contested that human experience is, by nature, dynamical; a claim supported by the prior work of James (James, 1890). As such, DST terms are currently becoming increasingly applied in literature concerning human experiences, particularly with regards to emotions (Lewis and Granic 2000(B); Mascolo et al., 2000). This work shall specifically discuss the relevance of feedback loops, attractors and catastrophe theory to the human experience of anger and aggression.
A Dynamic Systems Approach to Anger and Aggression

In 2005, Lewis contested that the dynamics of an emotional expression can be divided into three fundamental junctures; a trigger, escalation, and stabilisation (Lewis, 2005). The following work aims to elucidate how each of these phases can be explained through the principles of Dynamical Systems Theory.

Cybernetics: An Introduction to Control Systems and Feedback Loops

Systems employ different methods of control, with varying levels of complexity. The simplest method of management consists of ‘open-loop control.’ Such a mechanism provides an input into a system, but does not monitor output. Explicitly, open-loop control systems do not utilise feedback to ascertain the effect of an input on the output of the system. As such, these control systems cannot counteract disturbances induced by the environment (Kuo, 1991); see Figure 1. Conversely, ‘closed-loop controls’ employ feedback mechanisms as a means to continuously monitor the current state of a system. As such, they are able to maintain stability through correcting for externally induced discrepancies; see Figure 2.

Figure 1: Open-Loop System

Figure 2: Closed-Loop System

Systems consequently self-regulate through utilising positive and negative feedback loops. Negative feedback loops serve to maintain homeostasis through counteracting any disturbances in a system (Robins and Novaco, 1999; Thomas et al., 1995). Conversely, positive feedback loops serve to amplify any encountered discrepancies (Carver, 2006; Granic and Patterson, 2006). As such, systems utilising positive feedback loops are intrinsically unstable, and can form the basis of the ‘runaway effect’ (Crespi, 2004).
As mentioned in the introduction, the vast majority of psychological research has been based on empirical methods employing the open-loop notion of cause-and-effect. Explicitly, research has aimed to determine the linear relationship between the input and output of a system. However, in 1973 Powers advocated a closed-loop explanation of human behaviour, involving feedback loops (Powers, 1973). He contended that an individual’s perceptions and behaviours exist in state of mutual influence, which feed-back into each other. The mathematical expression of such a relationship is called a feedback function.

If the experience of anger and aggression were to be under open-loop control, it is conceivable that they would dissipate following an initial trigger. This concept relates to the notion of the cathartic effect of aggression (Konečni, 1975; Konečni and Ebbesen, 1976). This suggests that the candid expression of anger and aggression subsequently results in lower levels of arousal and antagonism. However, as previously mentioned, Powers suggests that human behaviour is influenced by closed-loop control (Powers, 1973). This suggests that the expression of anger and aggression would be influenced by feedback loops. In such a case, if the individual’s resting disposition was one of neutrality, then negative feedback loops would work to reinstate this condition. Positive feedback loops however would serve to escalate the situation through enhancing the expression of anger, and encouraging aggressive acts. Explaining anger through positive feedback loops would account for the observation that demonstrations of anger have a tendency to elicit an in-kind response, which in turn legitimises the original emotional expression and increases the likelihood of an antagonistic response (Robins and Novaco, 1999). As such, positive feedback “contributes to the precipitation and escalation of violent behaviour” (Kruk et al., 2004, p1062). Furthermore, sequestered positive feedback loops become ‘vicious circles’ (Thomas et al., 1995). As such, the concept of feedback loops provide a dynamical systems explanation for Lewis’ second stage of emotional expression; escalation.

Additional research, implicating positive feedback loops in the expression of anger and aggression, includes that of Beale and colleagues, which suggests that “violence breeds violence” (Beale et al., 1999, p233). This research demonstrated a systems memory effect for
pub violence. In other words, following an initial act of aggression in these venues, the probability of a further in-kind act was increased. The concept that a systems memory effect occurs with aggressive incidents is further supported by ‘Social Interactionist Theory’ which suggests that minor altercations frequently escalate into more serious aggressive incidences (Tedeschi and Felson, 1993).

**Stuck in a Vicious Circle: The Concept of an Absorbing State as Related to Anger and Aggression**

To this point, it has been discussed that the expression of anger and aggression can be escalated, prolonged and repeated through the involvement of positive feedback loops. However it is important to note that such feedback loops do not simply have a short term effect. DST suggests that over time, reoccurring patterns of behaviour stabilise (Nowak et al., 2005). Expressly, aggressive responses that may be encouraged through positive feedback may eventually become automatised, habitual reactions. In this situation, anger and aggression become attractors, or absorbing states, which ‘attract’ the system away from competing states (Granic and Patterson, 2006; Thayer and Lane, 2000).

The presence of absorbing states can be depicted by mapping trajectories, or temporal changes of a system, onto a state space diagram (Vallacher and Nowak, 1997). The establishment of attractors can be likened to the effect of heavy rain: heavy rain can cause furrows in soil; after these furrows are established, further rain fall is likely to result in water pooling in these areas; with each downfall, the size of these furrows would be increased. The breadth, incline and depth of an attractor basin all denote information regarding the strength of the absorbing state; see Figure 3. A broad absorbing state signifies that a wide range of trajectories are ‘attracted’ to it. The incline of an attractor on the other hand denotes how precipitously trajectories will enter the state, while the depth of the state indicates how engrained the system is in the attractor; the deeper the state, the more difficult it will be to escape it (Nowak et al., 2005).
If either anger or aggression becomes established as absorbing states, these responses would develop higher inertia. Inertia refers to a response’s resistance to change (Robins and Novaco, 1999). Thus heightened inertia for these responses would serve to further escalate problems. Previously it was noted that negative feedback loops maintain equilibriums, and as such can serve to dissipate anger if an individual’s resting disposition is neutrality. However, it could be contested that should anger or aggression become a predominant absorbing state, the individual’s natural disposition will be one of these responses. In other words, negative feedback would serve to return the individual back to a state of anger or aggression, while positive feedback would continue to enhance this affect. In such a condition, negative feedback loops will effectively equate to positive feedback loops, and the system will stabilise around this absorbing state (Nowak et al., 2005). Moreover, should movement from the attractor be attempted, forces would be instigated that reinstate the system to its absorbing state (Nowak et al., 2005; Vallacher and Nowak, 1997); thereby rendering the individual in an unequivocally vicious circle. It is suggested that this may be the case for individuals with clinically disordered anger or aggression (Thayer and Lane, 2000). This provides an explanation for Lewis’ third stage of emotional expression; stabilisation. Once stabilisation around an emotional state has occurred, this response becomes an integral element to an individual’s personality (Nowak et al., 2005).

Given the above, the concept of absorbing states could be utilised as a means to explain the notion of ‘cycles of abuse.’ It has been reported that individuals who have suffered from
physical or sexual abuse at the hands of their parents are significantly more likely to abuse their own children (Pears and Capaldi, 2001). It is suggested here that this may be a result of such behaviours becoming established as system attractors. Broadbent (1981) argues that individuals carry various representations of previous life events, or schema. If these events become a re-occurring pattern in an individual’s life, it is arguable that they could in turn establish themselves as an absorbing state. It is important to note at this point that although these states may ‘attract’ responses away from competing states, it does not adumbrate that these states are in themselves attractive. This may explain why some parents, apparently unwillingly, engage in abuse.

Such a suggestion could have interesting implications, should it be empirically tested. Although attempting to counter current attractors may result in reinstating that condition (Nowak et al., 2005), attractors can be overridden through the establishment of new absorbing states (Coleman et al., 2007). This suggests that ‘cycles of abuse’ could be broken by establishing different, more benign system attractors. This may explain the observation that previously abused individuals who receive emotional support from their partners are less likely to abuse their children than those who do not receive such support (Egeland, 1988; Milan et al., 2004). Explicitly the provision of emotional support may establish a new attractor for the system.

**Establishing a difference: Absorbing States, Stubbornness and Self Determination**

It is important to note the differentiation between the ‘attraction’ of an absorbing state and the experience of both stubbornness and self-determination. Attractors are established through repeat occurrence of behavioural responses. As such, absorbing states almost represent a system’s memory for past events. Conversely, stubbornness and self-determination, far from being habitual responses, are self-motivated states. Expressly, absorbing states simply ‘attract’ a system into habitual responses, while stubbornness and self determination on the other hand represent states actively induced by a system.
Taking advantage? The Relation Between Absorbing States and Tantrums

As absorbing states represent prepotent responses, returning to an absorbing state does not necessarily require the motivation of an individual. Expressly, if anger or aggression were the predominant attractors of a system, then probability suggests the system would return to these states without excess provocation. However, it would be interesting to assess if individuals can take advantage of absorbing states. Explicitly, can a system encourage trajectories to an attractor, knowing it will be difficult to then escape it? This concept could be related to the experience of tantrums. Tantrums appear to be self-motivated escalations of antagonistic responses. Therefore, does the individual instigate these responses, knowing they will be drawn into an attractor that will effortlessly assist the maintenance of their initial response?

Catastrophe Theory, Anger and Aggression

If two attractors are present in a system, behaviour can be explained through the principles of catastrophe theory (Thom, 1975). Catastrophe theory originated in the 1960s with the research of René Thom, but was popularised by Zeeman a decade later (Zeeman, 1977). Catastrophe theory is a subdivision of bifurcation theory which explains how small changes to an independent variable can render large, or catastrophic, changes in a dependent variable (Stewart and Peregoy, 1983; Vallacher and Nowak, 1997; Yiu and Cheung, 2006). Explicitly, the theory suggests that the independent variable and dependent variable are related via a splitting factor. With regards to anger or aggression, the dependent variable would relate to the intensity of either of these two responses, whilst the independent variable would relate to provoking circumstances. The splitting factor would specify the extent to which these factors are linked through positive feedback (Coleman et al., 2007). If the positive feedback between the independent and dependent variable is low then anger and aggression would continue along a linear function. However if there were considerable positive feedback loops between anger/aggression and their instigating factors, then after reaching a certain threshold (the tipping point), a catastrophic change would be evident in the dependent variable; see Figure 4. Once this has occurred, the response demonstrates high inertia (Robins and Novaco, 1999). Thereafter, returning the system back to a baseline response is considerably more difficult even after the instigating factors are removed.
Figure 4: Catastrophe Model of Anger/Aggression

Note: When positive feedback is low, an increase in instigating factors shows a linear relationship with the expression of anger. When positive feedback is high, the anger/aggression response will follow a similar trend until it reaches a threshold. At this point, a catastrophic change occurs in the dependent variable; emotional expression.

When Zeeman initially introduced the principles of catastrophe theory to psychology, the model was regarded incredulously. However, despite the initial controversy over the utility of the approach, the theory has now been used to model a vast number of complex human behaviours, including attitude change (Flay, 1978), and Anorexia Nervosa (Zeeman, 1976). As such the potential utility of this theory in explaining the expression of anger and aggression should not be ignored.

**Furthering Scientific Knowledge: The Applications of a Dynamic Systems Approach**

**Approach to Anger and Aggression**

As previously mentioned, the vast majority of psychological research has investigated emotional disorders using methods based on the open-loop concept of cause and effect. However, considering anger and aggression through the principles of DST illustrates the mutual effect of the individual and their environment. As such, a dynamic systems approach to anger and aggression provides insight into emotional disorders that is not available simply through considering the linear relationship between the inputs and outputs of a system. Using DST it is possible to map out likely trajectories for these emotional responses, and furthermore use this knowledge to develop suitable interventions. This broadens current
scientific knowledge regarding the experience of anger and aggression. Should the concepts in this work be formalised through empirical testing, using transitional frequency matrices, findings would have a number of interesting implications for a variety of different fields. For instance, a DST approach to anger could be applied to: occupational psychology, street violence, international politics and anger management therapies.

Occupational psychology could utilise the principle of DST to prevent the escalation of anger and aggression in a work place setting. This in turn would render a better work environment, one that would be more conducive to efficient work. The application of such research could be particularly constructive in times of economic turbulence, where obtaining the most from employees is of notable importance.

Applying a dynamical systems approach to conflict more generally could also have vast implications for international politics. For instance it could help inform decisions regarding the use of nuclear arms or general retaliation in conflict scenarios. The research described in this work suggests that the presence of positive feedback loops serve to escalate anger and aggressive responses (Kruk et al., 2004), which can, in time, establish themselves as attractors. This suggests that international threats may serve to escalate conflict situations. Furthermore the reoccurrence of such events may result in these reactions becoming prepotent, or default, responses. This suggests that engaging in international acts of aggression may have detrimental effects outside of the foreseeable future. Taking such a perspective may well advocate a position of international pacifism.

The most significant application of such research is to anger management treatments. Current research suggests that attempting to withdraw from attractors may result in the reinstatement of that condition (Nowak et al., 2005). As such, anger management techniques that directly attempt to interfere with angry or aggressive responses may not be beneficial. Research does however also contend that attractors can be overridden through the establishment of new absorbing states (Coleman et al., 2007). This suggests that clinical treatments for anger disorders may be more productive if they focus on establishing new, more benign prepotent system responses. The concept of establishing adaptive prepotent responses is one that is already applied in military Special Forces training, whereby individuals are trained to automatise constructive responses to hostile situations (Robins and Novaco, 1999). This is particularly important in these specific situations as high arousal can impede cognitive processing and minimise self-control (Hamilton and Warburton, 1979). As
previously mentioned DST principles could also be utilised to break ‘cycles of abuse,’ once again, by establishing more benign habitual responses.

**Conclusion**

Despite the prevalence of disordered anger in society (Lachmund and DiGiuseppe, 1997), relatively little scientific research has been published regarding this emotion. Furthermore, the vast majority of existing research into this area has utilised methods based on the open-loop notion of cause and effect. Despite this, Powers suggest that in order to understand a system’s behaviour, it is necessary to consider the mutual influence of the individual and their environment, as mediated through feedback loops (Powers, 1973). As such, a dynamic systems approach to anger and aggression has been discussed. Explicitly dynamic systems concepts such as feedback loops, attractors and catastrophe theory have been applied to the emotional responses of anger and aggression.

Lewis (2005) contended that emotional expressions follow three discrete stages: trigger, escalation, and stabilisation; the principles of dynamics systems theory have been applied to these concepts. Expressly, escalation has been explained through the involvement of feedback loops, while stabilisation has been explicated in terms of absorbing states. Furthermore, it is suggested that open-loop methodologies are indubitably insufficient for the study of emotional expressions. Explicitly, the processes by which moment to moment emotional expressions stabilise, and become incorporated into an individual’s personality, cannot be accounted for by methodologies which ignore the dynamical changes of a system. The implications of a dynamical systems approach to anger/aggression have been considered, specifically with relation to occupational psychology, street violence, international politics, anger management therapies and ‘cycles of abuse.’ It is suggested that through considering the dynamical aspect of emotional experiences, scientific knowledge can be extended beyond the realms of simple cause and effect relations. This not only refines our understanding of anger and aggression as responses, but in turn aids the development of appropriate interventions for disordered emotional reactions.

*Word Count: 3,722*
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