Experiential learning as preparation for leadership: an exploration of the cognitive and physiological processes

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ABSTRACT

Purpose

The objective of the study was to explore whether challenging experiences on development programmes would simulate leadership challenges and therefore stimulate the body's autonomic nervous system response. We also aimed to determine whether increase in autonomic arousal would be related to learning, and/or moderated by personality variables.

Design/methodology/approach

The research used heart rate monitors to measure heart rate continuously over a two-day simulated learning experience. This was used to calculate autonomic arousal which was taken to be the difference between resting heart rate measured during sleep (HR) and HR during critical incidents (ΔHR). We correlated this with self-reports of learning immediately after, and one month after, the programme to assess the impact of autonomic arousal on perceived learning, as well as with variety of psychometric measures.

Findings

The research found significant correlations between (ΔHR) during critical incidents and perceived learning which were not related to personality type. The research also found a significant correlation between (ΔHR) and learning during a control event for individuals with 'approach' personalities.

Research limitations

Whilst a significant result was found, the sample size of 28 was small. The research also did not empirically assess the valence or intensity of the emotions experienced, and used only a self-report measure of learning. Future research should replicate the findings with a larger sample size, attempt to measure these emotional dimensions, as well as obtain perceptions of learning from direct reports and line managers.

Originality / value

The research extends the literature regarding the value of learning through experience, the role of autonomic arousal on learning, and the impact of negative emotions on cognition. The research makes a unique contribution by exploring the impact of experience on arousal and learning in a simulated learning experience and over time, by demonstrating that simulated experiences induce emotional and physiological responses, and that these experiences are associated with increased learning.

INTRODUCTION

In the past decade the world of work has changed greatly. Technological advances have broken down geographical borders, reduced manufacturing and operating costs, and have provided greater access to larger markets and cheaper suppliers, resulting in a fast moving and competitive climate. Working across geographies, functions and cultures presents today's leaders with greater challenges than ever before (Hogan, 2010), and requires continuous improvements in the quality of leadership.

Research suggests however, that there is still a shortage of talented, job-ready candidates to meet these demands, and organisations are struggling to fill management and executive roles with individuals ready to cope with the challenges of leadership (DeGeest & Brown, 2011). The onus therefore, is on leadership development practitioners to improve leaders' capabilities to "engage with the complex, dynamic, chaotic and highly subjective, interactional environments of contemporary organisational life" (Sutherland, 2013), by creating new and innovative ways of developing leaders.

The purpose of this paper is to explore the value of experiential learning as one such method. It will begin with a discussion of the relevant research regarding the impact of experience on both memory and learning, and explore the influence of emotion, cognitive load, and the body's physiological response to stress on that impact.

THEORETICAL BACKGROUND

Learning through experience and challenge

Experiential learning is defined by Kolb (1984) as the process of knowledge creation through the transformation of experience. The theory contends that in the management arena, real learning occurs through engagement in challenging experiences, and later reflection on those experiences (Hoover, Giambatista, Sorenson & Bommer, 2010; DeRue & Wellman, 2009). Research has found learning through experience to be related to the development of both critical leadership competences, such as cultural intelligence (Li, Mobley & Kelly, 2013), and to provide a valuable vehicle for preparing oneself for future leadership challenges and development as a leader (Conger, 2004; Pye, 1994).

The level of challenge and stretch in the experience would also appear to be important, as more challenging experiences require leaders to acquire new skills and knowledge, and result in more developmental learning (McCall & Hollenbeck, 2005). Dragoni, *et* al (2009) suggest that, as challenging work experiences require employees to solve complex problems, they present opportunities to learn new skills, competences and knowledge.

Research also suggests that on the job experience might be more valuable than formal training (McCall, 2004). In support of this proposition, Thomas and Cheese (2005) found that leaders, corporate executives, and entrepreneurs, learned more from real work and life experiences than from leadership development or MBA programmes. Useem, Cook and Sutton (2005) however, argue that business school programmes such as MBAs, can be valuable learning opportunities, resulting in improved future decision making under pressure. Specifically, they argued that programmes which incorporate simulated learning experiences prepare leaders for future challenges through the simulation of challenging decision making situations.

Learning, experience and emotion

Learning through experience, whether on the job or through simulations therefore, would appear to be a valuable vehicle for learning. However, research suggests that for such experiences to have long-lasting effects, they need to be emotionally charged, and a wealth of research exists that has shown that emotional experiences are retrieved more reliably from memory than neutral events (Buchanan, 2007; Reisberg & Hertel, 2004). This has been demonstrated in a number of research studies (Christianson & Loftus, 1987; Heuer & Reisburg, 1992; Rubin & Kozin, 1984). For example, Rubin and Kozin (1984) interviewed students about their clearest memories and found that vividness of memories correlated with their rated importance, degree of surprise and emotionality of the recalled experience. The neurological explanation for this lies in the substantial connections which exist between the hippocampus, which is involved in accessing memories, and the amygdala, which is involved in processing emotion (Phelps, 2006). Activity in the amygdala has been demonstrated to enhance encoding in the hippocampus, and these additional emotional cues are stored in long term memory, facilitating the retrieval of that memory (Cahill & McGaugh, 1998). In this way, the amygdala has a role in both modulating and enhancing the memory of emotional experiences, resulting in strong recall of emotionally charged experiences (Rüegg, 2004).

Whilst the importance of emotion has been clearly demonstrated, the relative impact on learning of negative versus positive emotions is less clear In respect of positive emotions, Hüther (2011) hypothesises that the presence of positive feelings is required for individuals to learn, since this leads to a sense of efficacy and personal growth. This hypothesis is supported by many studies that have demonstrated that positive emotions improve learning (Isen, Daubman, & Nowicki, 1987; Isen & Reeve, 2005). A study by Bolte, et.al, (2010), for example, found that increased experience of positive emotions during a learning event was related to cognitive flexibility and openness to information, both important processes in problem-solving. However, others have found positive emotions to be inversely associated with learning (Seibert & Ellis, 1991; Oaksford, Morris, Grainger, & Williams, 1996). For example, Oaksford *et al.* (1996) found that positive mood rather than negative mood decreased cognitive performance.

The research regarding negative emotions and learning is also contradictory. Some studies have found that negative emotions narrow thoughts and reduce learning (Fredrickson, 2001; Gaspar, 2003). Gasper (2003) for example, found that negative emotions reduced the number of alternative solutions applied to problem solving in a learning environment. Others however, have found the opposite effect. D'Mello and Graesser (2011) for example, found that negative emotions of confusion and cognitive disequilibrium, often associated with failure, were related to deeper learning in their student sample. They postulate that this is the result of the effortful cognitive activities (reflection, problem solving, and deliberation) in which participants engaged in order to restore the equilibrium and resolve the confusion.

The contradictory nature of the research regarding emotion and learning could be explained by the varying impact of two dimensions across which emotions vary: valence and intensity (McConnell & Eva 2012). The critical element for both memory and learning therefore, might be the intensity of the emotions rather than the valence, which is supported by the more consistent nature of intensity findings regarding emotion and memory. For example, Thompson (1997) found no effect for valence on forgetting rates of personal events, but a strong effect for intensity. Similarly Talarico, LeBar and Rubin (2003) found intensity to have more consistent and stronger effects on vividness of recall, length of retention of memory, and a range of properties of autobiographical memories.

In summary, it would appear that for experiences to result in learning they also need to involve emotion, and this emotion, whether positive or negative, needs to be felt with some intensity.

The body's autonomic response to arousal

Research from the field of neuroscience adds further weight to this argument. For example, studies examining the body's physiological response to emotional stimuli have found that skin conductance response, which is a marker of autonomic activity, increases in response to the perceived intensity of emotional arousal, regardless of valence (D'Hondt et. al, 2010). This is one component in our response to perceived stress (McEwen, 2008; 2012).

This stress response also helps explain the impact of negative experience on learning. When we perceive stress, a system is activated which results in increased adrenaline within the body, which raises heart rate, respiratory rate and blood pressure. In addition, this system causes increases in the release of neurotransmitters in the prefrontal cortex (planning) and hippocampus (memory: McEwen, 2008; 2012). In acute stress situations, this brings more cognitive resource to the problem increasing the use of memory for previous situations and the ability to plan creatively in order to provide the optimum response to the challenge. The level of stress perceived, and individual differences in the intensity of the stress response, control the degree to which this system is activated. A moderate stress response results in increases in cognitive performance, but a strong stress response can result in over reliance on past solutions at the expense of more creative solutions. Our ability to plan decreases. This is partly due to a change in the weighting of our response to reward and threat under stress (Mather & Lighthall, 2012). Perceived stress increases our selection of previously rewarded solutions while impairing our avoidance of previously negative outcomes. As such, we are less likely to select optimum solutions under stress suggesting that more extreme stress results in a decrease in cognitive performance (Mather & Lighthall, 2012). The level of stress at which performance decreases will be different across individuals (Lupien, McEwen, Gunnar & Heim, 2009).

Perceived stress results in release of adrenaline which causes changes in the activation of the autonomic nervous system (sympathetic and parasympathetic nervous system). The activation of our sympathetic/parasympathetic nervous system can be indexed by a measure of heart rate variability (HRV), the heart rate's fluctuation around the mean (Riganello, Gerbarino & Sannita, 2012). The cognitive impact of these states of challenge or threat was demonstrated by Kassam, Koslov & Mendes (2009) who found that participants who exhibited cardiovascular responses consistent with 'challenge' performed better in a cognitive adjustment task than those whose cardiovascular responses were consistent with 'threat'.

The impact of stress on cognition forms the basis of several cognitive theories, such as activation theory (Scott, 1966), cognitive resource theory (Fiedler & Garcia, 1987), and cognitive load theory (Sweller, 1994). Activation theory contends that the degree of activation, or arousal in cognitive processing increases with how novel, uncertain or meaningful a stimulus is (Berlyne, 1960). Greater levels of arousal are related to improved cognitive processing, including learning, but to a point. Past this point of arousal, the cognitive benefits are muted by increasing anxiety and uncertainty (Scott, 1966). Similarly, cognitive resource theory and cognitive load theories also postulate that experiences that become stressful divert cognitive resources away from the task towards concerns about failure and poor evaluation. This leads to cognitive overload as the individual is concerned with both the task and anxieties, and has been found to result in diminished cognitive performance (Sutcliffe & Weick, 2008). DeRue and Wellman (2009) argue that over arousal and cognitive overload induced by highly challenging developmental experiences can be mitigated by the availability of feedback opportunities that reduce the uncertainties of the experience and allow the learner to focus on learning.

It would appear therefore that emotionally laden experiences can have a positive impact on cognition and learning, and as such, leadership development programmes that incorporate such experiences should be effective. However, when the experiences become too arousing and stress inducing, learning is impeded as cognitive resources are concentrated on finding a previous solution to the task rather than creating a new solution. The research suggests therefore, that effective development processes must also incorporate feedback opportunities in order to maintain an equilibrium.

Objective of the research

The aim of the current research was to explore whether experiential learning on a leadership development programme that invokes a level of arousal would mimic the challenging experiences of leadership and induce the body's sympathetic nervous response, as measured by changes in heart rate (HR). By equipping participants with the resources and support to encourage them to respond in 'challenge' rather than 'threat' state, such experiences might be expected to improve rather than impede cognitive performance and enhanced learning. We therefore predicted that increases in heart rate would be associated with increases in perceived learning.

As research suggests that personality variables may have an impact on individual responses to emotional stimuli as well as learning, the study also explored whether different personality variables would moderate the relationship between the experiences and changes in HRV and subsequent perceived learning. For example, individual differences in negative emotional arousal have been found to moderate the effect of stress on cognitive performance (Abercrombie, et al. 2012), and variables such as level of anxiety have been shown to be positively correlated with sympathetic nervous system response (Friedman, 2007). Similarly, research also suggests that individuals with high behavioural inhibition scores react with more intense negative affect in response to stimuli perceived as threatening (Carver & White, 1994; Updegraff, Gable & Taylor, 2004), and that this response has been related to poorer visuospatial working memory performance (Shackman et. Al, 2006). Finally, Bele, Könye, and Majerle (2009) found that students with higher optimism scores, as measured by the Life Orientation Test-Revised (LOT-R) (Scheier, Carver& Bridges, 1994), had higher subject grades than those with lower scores. As such, personality might be an important moderating factor in the positive or negative impact of emotional arousal on our ability to learn from experience.

The research questions:

1. Does experiential learning authentically reflect the reality of the challenges of leadership?
2. Do such experiences lead to a sympathetic nervous system response, as measured by increases in heart rate?
3. If increases in heart rate do occur, are these related to increases in perceived learning?
4. Does personality impact individual physiological responses, and if so, does this in turn impact perceived learning?

METHODOLOGY

Participants

The research involved 28 participants on two identical experimental versions of Ashridge Business School's *The Leadership Experience (TLE)* programme (14 per programme). The group comprised nineteen males and nine females, the average age of whom was 39, ranging from 26 to 55. Participants were a mix of Ashridge Executive MBA students and employees from Ashridge client organisations, and came from both public and private sector companies.

Procedure

The two, two day programmes, set up purely for the research, were residential, held at Ashridge Business School in Hertfordshire. Participants were fitted with heart rate monitors upon their arrival, which they were instructed to wear at all times, including whilst sleeping. The programmes consisted of a simulated exercise where participants ran a company of the future, during which time they had to deal with two critical incidents typical of leadership challenges, including dealing with a difficult conversation, and public speaking. Also included was a physical group activity at the end of the programme which was designed as a positive experience likely to increase heart rate. Since this was not designed to simulate a critical incident, it was not expected to be related to learning.

Two weeks prior to the programmes participants completed a pre-programme survey which assessed state/trait anxiety, life orientation, and behavioural approach/inhibition, as detailed below, providing a baseline measure of the constructs. Once the programme had commenced, participants were given the opportunity of either being involved in two critical incidents, or observing them. The 'difficult conversation' incident involved participants conducting difficult conversations with two actors. The 'communication' incident involved participants responding to questions posed to them live, in front of a camera. Following each critical incident participants were asked to reflect on the experience and complete a state anxiety questionnaire. Immediately after the programmes participants completed a learning questionnaire exploring their reported learning immediately after the programme (Time 1). The same questionnaire was completed again one month after the programme (Time 2).

Measures

Heart Rate Monitors

The activation of our sympathetic nervous system can be indexed by a measure of heart rate (HR), measured as the time between successive R waves (Sgoifo, Braglia, Costoli, Musso, Meerlo, Ceresini & Troisi, 2003). This measure has been shown to correlate with stress scores during a stressful interview. As such, change in HR between rest and a critical incident was used to provide a proxy measure for neural activity in the sympathetic nervous system as a result of increased arousal. The difference between participants' resting heart rate overnight and maximum heart rate during the critical incidents was used to provide a measure of 'difference in HR' (ΔHR). Average resting heart rate was calculated as the mean heart rate across a 10 minute period measured at 04:30 in the morning. Heart rate for critical incidents was measured as the maximum heart rate averaged across a 30 second moving window during a 10 minute period centred around the critical incident (the same period was used for all participants). The change in heart rate during a critical incident was calculated as the maximum heart rate during the incident minus the average resting heart rate.

Learning Questionnaire

The learning questionnaire was composed of 28 questions based on the competences that the programme was designed to develop. Participants were asked to indicate their agreement with statements on a 5 point Likert scale, ranging from 'strongly disagree' to 'strongly agree'. Negatively framed questions were reversed scored so that a higher score on this measure represents a greater level of perceived learning. Scores on these questions were used to reduce data to 4 factors on the basis of high inter-item correlations (> 0.35). Principal components analysis was used to determine composite factors from these questions. Initial eigen values indicated that the first four factors explained 27%, 12%, 11% and 9 % of the variance respectively. A four factor solution was chosen because of levelling off of the scree plot after this. The first factor was 'self as leader' and this consisted of questions such as: "*I feel more aware of my strengths as a leader*". The second factor, 'adapting to others' related to responses to others and the ability to adapt when dealing with others and consisted of questions such as "*I see more clearly the need to adapt my style to suit different people in different situations*". The third factor, 'difficult situations' included questions such as "*I feel better able to manage conflict with my peers*". The final factor, 'learning and development' contained more general questions about learning and development during the programme, for instance: "*I now see more clearly my responsibility for my own learning*". See *Appendix I* for details of the full questionnaire.

State-Trait Anxiety Inventory (STAI)

The STAI (Spielberger et al, 1983) comprises separate self-report scales for measuring state and trait anxiety. The state scale consists of twenty statements that evaluate how respondents feel 'right now, at this moment', such as '*I feel self-confident'*. The trait scale consists of twenty statements that assess how people 'generally feel'. Participants are asked to indicate their agreement with statements on a 4 point Likert scale, ranging from 'not at all' to 'very much so'. When scoring these scales, answers to positive questions were reversed so that a high score on these measures represents the presence of anxiety.

Life Orientation Test-Revised (LOT-R)

The LOT-R (Scheier, Carver& Bridges, 1994) assesses individual differences in generalised optimism versus pessimism. The scale consists of ten statements such as *'I hardly ever expect things to go my way'*. Participants are asked to indicate their agreement with the statements on a 5 point Likert scale, ranging from 'I disagree a lot' to 'I agree a lot'. When scoring this questionnaire, answers to negatively framed questions were reversed so that a high score on this measure represents the presence of optimism.

Behavioural Approach Scale / Behavioural Inhibition Scale (BAS/BIS)

The BAS/BIS (Carver & White, 1994) assesses individual differences in motivational systems. A behavioural approach system (BAS) is believed to assess appetitive motives, in which the goal is to move toward something desired. A behavioural avoidance (or inhibition) system (BIS) is thought to assess aversive motives, in which the goal is to move away from something unpleasant. The questionnaire consists of 24 statements such as *'When I want something I usually go all-out to get it'*. Participants are asked to indicate their agreement with the statements on a 4 point Likert scale ranging from 'very false' to 'very true'. The BAS scale is divided into three sub-scales: drive, fun seeking and reward responsiveness. The BIS scale is not divided into sub-scales. For the Behavioural Approach Scale, negatively framed answers were reverse scored so that a high score on this measure indicates a greater likelihood to approach something desired. The scores on the Behavioural Inhibition Score were reversed for positively framed questions so that a high score on this measure indicates a greater likelihood to avoid something unpleasant.

FINDINGS

Change in heart rate

The average resting heart rate measured in beats per minute (BPM) for participants was 60.4 bpm (range 41 – 74 bpm). A repeated –measures ANOVA was used to determine whether there were differences in heart rate between resting and each of the critical incidents. Maximum heart rate measured during three critical incidents was: Difficult conversations (mean HR = 81.3 BPM); Communications to Company (mean HR = 91.7 BPM) and a Group Activity (mean HR = 94.7 BPM)). There was a significant main effect of condition on heart rate ($F_{3,63} = 31.68$, $p < 0.001$). Pairwise comparisons with Bonferroni adjustments for multiple comparisons were run to determine where significant differences lay. In all cases, there was a highly significant increase in mean heart rate during the critical incident compared to baseline (all $p < 0.0001$). In addition, the heart rate in the Difficult Conversations incident was significantly lower than the other critical incidents (all $p < 0.007$).

[ADD TABLE 1]

Correlational analysis was used to determine the relationship between resting heart rate and heart rate during the critical incidents (*Table 1*). We used a bootstrapping technique to determine 95% confidence intervals as a means of demonstrating the strength of correlations and only correlations where the 95% confidence intervals do not span 0 are reported. This technique improves on the use of Bonferroni corrections as it protects against both Type I and Type II errors (Field, 2013). Interestingly, while there was a significant correlation between resting heart rate and the heart rate during the group activity, there was no significant correlation between resting heart rate and heart rate during the Difficult Conversation, or during the Communications to Company incident.

Using each individual's resting heart rate (measured when sleeping) as a baseline measure, the average increase in heart rate (ΔHR) for the two critical incidents and the group activity was calculated (*Table 2)*. This shows that heart rate rose substantially during the critical incidents and the group activity. However, there was greater variability in heart rate change during the critical incidents than during the group activity.

[ADD TABLE 2]

Correlation analyses investigated the relationship between these changes in heart rate (ΔHR) during the two critical incidents (CIs) (Difficult Conversation and Communication to Company) as well as the group activity, and the four learning factors. A further linear regression analysis was also used to investigate the relationship between ΔHR during the critical incidents and the group activity, and the personality measures, and between personality measures and the four learning factors.

Thirteen of the participants had previous experience of programmes at Ashridge while the remaining 10 had no experience. We used a MANOVA to test whether any of the heart rate measures differed between groups (HR during critical incidents, group activity and at rest). There were no significant differences in any of these measures between those that had been to Ashridge before and those who had not.

Heart rate variance and perceived learning

Difficult Conversation Critical Incident

We conducted a correlational analysis to determine whether increases in heart rate were associated with improvements in perceived learning. We used a bootstrapping technique to determine 95% confidence intervals as a means of demonstrating the strength of correlations. This technique protects against both Type I and Type II errors. Since we predicted positive relationships between change in heart rate and learning, only correlations where the 95% confidence intervals do not span 0 are reported. There were significant correlations between ΔHR during this CI and learning scales 'Self as Leader' 'Difficult Situations' and 'Learning and Development' at Time 1 (immediately post programme). There was also a significant correlation with 'Learning and Development' at Time 2 (one month post programme). See *Table 3* for full results.

Communication Critical Incident

There were significant correlations between ΔHR during this CI and learning scales 'Self as Leader' and 'Learning and Development' at Time 1 and 'Learning and Development' at Time 2.

Group Activity

There were also significant correlations between ΔHR during this session and learning scales 'Learning and Development' at Time 1 and Time 2.

[ADD TABLE 3]

Differences in Learning between the Critical Incidents

The Fisher r-z transformation (Fisher, 1915) was used to determine whether there were significant differences between correlations for the different learning experiences. No significant differences were found.

Heart rate, perceived learning and personality

Whilst there were no significant correlations between ΔHR and the personality measures, there were correlations between the change in heart rate between rest and 'group activity' on these questionnaires.

ΔHR during the group activity correlated significantly with the BAS 'Drive' and 'Reward Responsive' scales (r=0.42, p=0.024; and r=0.50, p=0.008 respectively). The scores on these scales also correlated positively with the scores on the 'Learning and Development' learning scale at Time 2 (r=0.33, p=0.048; and r=0.36, p=0.037 respectively).

A regression analysis was performed to determine whether variance in BAS 'Drive' and 'Reward Responsive' scales contributed to scores on the 'Learning and Development' subscale at Time 1 after accounting for variance in ΔHR during the group activity. In model 1, ΔHR was entered as a predictor of 'Learning and Development' scores. However, when scores on the 'Drive' and 'Reward Responsiveness' subscales of the BAS were entered into the model with ΔHR there was no predictive effect on 'Learning and Development' scores. A similar pattern of results was obtained when the analysis was repeated using 'Learning and Development' scores at Time 2.

[ADD TABLE 4]

In order to investigate this further, we conducted path analysis. Regression analysis for predictors of variance in 'Learning and Development' score at Time 1 demonstrated a significant effect for change in heart rate from rest during the group activity but not for either subscale of the BAS. A similar pattern was found for Time 2. Instead, the BAS Drive score was found to be a predictor of variance in change in heart rate from rest during the group activity. BAS reward responsiveness score co-varied with BAS Drive score, but was not predictive of variance in change in resting heart rate in the group activity. This suggests that the effect relationship between change in HR in the group activity and 'Learning and Development' scores is a direct relationship which is not mediated by Approach personality scores.

[ADD FIGURE 1]

DISCUSSION

The objective of the study was to explore whether challenging experiences encountered on leadership development programmes would simulate real leadership challenges, stimulate the body's sympathetic nervous system response as measured by changes in heart rate, and whether any change would be related to learning, and/or moderated by personality variables. The significant increase in ΔHR recorded during the critical incidents on the programme suggests that despite the fact that the individuals knew the simulated situation was not 'real', most did actively engage in the scenario, and were concerned enough about their performance to cause an increase in level of arousal. Critically, the study also found that the increase in ΔHR during the critical incidents was significantly related to perceived learning immediately after the programme for three of the four learning factors (self as leader, difficult situations, and learning and development) and to perceived learning one month after the programme for the learning and development factor. This was also apparent for participants whether they were actively involved in the difficult conversation critical incident, or simply observing it. As such it would seem that the stress response and associated learning can happen vicariously.

As these findings were not moderated by scores on the personality psychometrics, this suggests that irrespective of personality type, if individuals engage in learning to the point that it raises their heart rate they are likely to perceive that they have learned across a range of measures, and this perception is likely to be maintained. This finding supports previous research that has found learning through experience, particularly challenging experiences, to be associated with the development of critical leadership skills (Li, Mobley & Kelly, 2013; McCall & Hollenbeck, 2005). It also lends weight to Useem, Cook and Sutton's (2005) argument that formal development programmes, rather than just on the job experience, can be valuable vehicles for learning, and supports earlier research from both neuroscience and cognitive learning theories that suggest that physiological arousal is associated with improved cognitive performance and learning (Kassam, Koslove, & Mendes, 2009; Scott, 1966).

Finally, contrary to research that found that personality variables such as anxiety or pessimism moderate physiological arousal and have a negative correlation with learning (Abercrombie, et al 2012; Bele, Konye & Majerle, 2009) the research found no significant correlations between ΔHR during critical incidents and state or trait anxiety or scores or the Life Orientation test. The research did however, find a positive correlation between the raised heart rate during the 'group activity' and the 'learning and development' learning scale after one month, but only for those with higher scores on the BAS 'drive' and 'reward responsiveness' scales. A regression analysis was conducted to determine whether individual differences in the BAS 'drive' and 'reward responsiveness' scales mediated the relationship between increased learning scores and ΔHR during the group activity. This analysis suggested that the BAS subscale scores were not contributing to the relationship between ΔHR during the group activity and change in heart rate. Previous research has shown that those with an 'approach' personality type are more sensitive to signals of reward and non-punishment, and are more likely to engage in goal-directed efforts and experience positive emotions such as elation, happiness and hope, when exposed to the possibility of such reward (Gray, 1982). The correlation between the raised ΔHR and learning found here might therefore indicate that these individuals were more engaged in the group activity than others and found the experience more enjoyable, which could lead to a greater sensitivity to the possibility of learning from the experience, a greater commitment to the learning experience and as such reports of greater perceived learning through general personal development.

Implications for practice

Given the findings, it would seem that simulations in a leadership development setting can indeed mimic the stress of real workplace experiences and should provide a safe practice ground for leaders to test out their responses in preparation for when they encounter them for real, and as such can be used to develop greater resilience for incidents that are typical of leadership (Maier & Watkins, 2010). In this situation, inadequate response to an incident does not result in negative consequences, and so learning can come from reflective processes that provide insight into how the incident could be approached differently in the future.

Given this finding, the implication for business schools and those responsible for leadership development is that in order to prepare leaders for the challenges of leadership, development needs to be hard-hitting, challenging, and present the potential for failure. Carefully taking leaders out of their comfort zone raises their heart rate, and improves both their cognitive performance during the experience and their perceived learning from it. There is however, a fine tightrope to walk between the 'challenge' or 'threat' response, and as such it is critical that these experiences are conducted by astute and experienced facilitators, and occur in a safe and supportive environment, with opportunities for feedback, mitigating as DeRue and Wellman (2009) suggest cognitive overload, reducing uncertainties, and helping participants to maintain focus on their learning.

However, as previous research suggests that rather than the positive or negative nature of the experience, it is the level of intensity of emotions which may have the greatest impact on learning (McConnell and Eva, 2012), it could be argued that high intensity positive experiences, such as those that may offer the potential for public success or the development of a positive self-concept may be just as effective as those that induce a level of stress. However, the authors would argue that the additional value of negative experiences may be found in the impact that previous success with challenging experiences has on individual's future perceptions of stress, which greatly impacts whether they respond in 'challenge' or 'threat' mode, and as such impacts their cognitive ability in the moment (Maier and Watkins, 2010). As such, through altering perceptions of future stressful events, practice with negative situations may help leaders to better respond to future leadership challenges.

This specifically has implications for leaders themselves, as even the most experienced leaders will face novel and unfamiliar situations which will test them in new ways. Being able to rise to the challenge, to perform during those critical incidents, is an important facet of effective leadership and for establishing credibility as a leader. It is vital therefore, that leaders create opportunities themselves to practice these situations, to alter their perceptions of stressful events and to ultimately perform in the future at their cognitive peak.

There are also implications in terms of how L&D departments evaluate the success of development interventions. Relying on the standard 'happy sheet' which typically only assesses participant's reactions to a learning experience immediately after it has happened may well provide L&D professionals with misleading information, as challenging experiences might not be well received in the moment, and true learning can take time to embed (Waller, 2012).

Until recently, leadership development has focused largely on changing observable behaviour, paying little attention to the underlying physiological processes which so strongly influence that behaviour. This study suggests however, that if we are to develop a more sophisticated and nuanced understanding of how leaders learn to lead, we need to look beneath the surface behaviour, to the underlying cognitive and neurological processes through which it manifests. Then we may be better placed to develop innovative methods which can accelerate leaders' development and prepare them for today's challenging environment.

Contribution, limitations and future research

The current research adds to the growing literature regarding the value of learning through experience and the role of physiological arousal in our ability to think clearly, make good decisions, and to learn. It lends support to research, such as D'Mello and Graesser (2011) and Ellis and Davidi, (2005) who argue that negative emotions, as likely experienced by our participants in response to the critical incidents, can result in deeper learning than more positive emotions. Critically, the research makes a unique contribution to the literature by exploring the impact of experience on arousal and learning in the field, in a natural setting, and over time, and as such facilitates the transfer of the findings to practice. It also contributes to the extant research by demonstrating that simulated experiences can induce emotional and physiological responses, and that these experiences are associated with increased learning.

One of the limitations of the study however, is the relatively small sample size, which whilst yielding significant results, may not have provided the most generalisable results. Furthermore, whilst participants were asked to complete a questionnaire recording their feelings after the critical incidents the nature of the data collected was not suitable for a thematic analysis and did not enable us to determine whether the intensity of their feelings was more important to their response than the valence. In addition, the measure of learning provided was self-report only. A 360 measure of learning, capturing the perspectives of line managers, peers and direct reports would have provided a more objective measurement. Future research therefore, should attempt to replicate the study with a larger sample size, a more objective assessment of learning, and empirically capture the nature of the emotional experience in order to better understand the impact of the two emotional dimensions.

In addition, drawing on previous research such as Maier and Watkins (2010) the authors infer from the results of the study that practice with stressful situations will likely lead to an improved ability to deal with similar situations in the future because having encountered them before and stored their response in their memory they perceive that they have the resources to deal with them (Reitz, Carr & Blass, 2007). This perceived resourcefulness can impact their perception of a stressful situation and as such make the difference between leaders responding in 'challenge' mode, and performing at their cognitive peak, or in 'threat' mode, impeding their cognitive performance (Kassam, Koslov & Mendes (2009). The study however, did not assess any change in perceived resourcefulness resulting from the programme nor follow up participants' perceptions of or ability to deal with future challenging situations. In order to demonstrate the power of experiential learning not just in terms of improving learning in the moment but also in terms of developing resourcefulness and future performance, future research should explore these factors and establish, empirically, that learning through experience enhances leaders' ability to rise to the challenges of leadership.

Appendix I: Learning Questionnaire

Self as Leader subscale questions

1. I feel more aware of my strengths as a leader
2. I feel more confident in my skills as a leader
3. I have greater confidence to meet the challenges of leadership in the future
4. I am now confident that I can take responsibility for making the decisions required of a leader
5. I have a clearer understanding about leading in uncertainty
6. I now have a better idea about how I react to uncertainty
7. I feel more confident about dealing with ambiguous situations
8. I feel more confident about my resilience in tough leadership situations
9. I feel more confident about handling stressful situations
10. I feel more confident about handling myself in stressful situations
11. I am much clearer now about whether leadership is for me or not

Adapting to Others subscale questions

1. I see more clearly the need to adapt my style to suit different people and different situations
2. I feel more motivated to adapt my approach with different people
3. I feel more sensitized towards other people
4. I feel more motivated to listen more effectively to others
5. I feel more appreciative of the power of feedback

Difficult Situations subscale questions

1. I have a better understanding of my personal impact on others
2. I feel more confident about tackling difficult conversations
3. I feel more confident about addressing performance issues
4. I feel better able to manage conflict with my peers
5. I feel more motivated to give feedback to others

Learning and Development subscale questions

1. I feel more aware of the areas I need to develop to be a better leader
2. I have a clearer understanding of my own leadership style
3. I have a clearer vision of the type of leader I want to be
4. I feel more motivated to develop myself as a leader
5. I feel that I have developed as a person over the course of the programme
6. I now see more clearly my responsibility for my own learning
7. I now have a better understanding of the critical incidents of leadership and the capabilities required to navigate them

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Activity	Mean ΔHR	Min ΔHR	Max ΔHR
Difficult Conversation	29 (6.1)	-1	92
Communication	37 (5.9)	-5	101
Group Activity	37 (3.4)	9	65

Table 2: Mean (standard error of the mean), min and max change in heart rate BPM between rest and Critical Incidents and the Group Activity

	Time 1				Time 2			
Change in Heart Rate	SAL	DS	ATO	L&D	SAL	DS	ATO	L&D
Difficult Conversations	0.42*	0.39*	0.30	0.48**	0.30	0.31	0.11	0.56**
	0.02	0.13	-0.18	0.11	-0.15	-0.43	-0.31	0.30
	0.68	0.67	0.73	0.74	0.67	0.64	0.63	0.78
Communication	0.34*	0.23	0.26	0.41*	0.28	0.03	0.17	0.35*
	0.01	-0.12	-0.26	0.09	-0.13	-0.29	-0.37	0.08
	0.64	0.56	0.74	0.66	0.57	0.35	0.69	0.67
Group Activity	0.23	0.31	0.17	0.50**	0.16	0.24	0.01	0.57**
	-0.18	-0.09	-0.20	0.02	-0.23	-0.26	-0.41	0.15
	0.60	0.69	0.56	0.82	0.52	0.64	0.42	0.84

Table 3: Correlation coefficients with 95% confidence intervals describing the relationships between the change in heart rate from resting in the two critical incidents and the group activity and the four learning scales at Time 1 and Time 2

Note: SAL = Self as Leader, DS = Difficult Conversations, ATO = Adapting to Others, L&D = Learning and Development

*$p<0.05$, **$p<0.01$

	b	***SE b***	***β***	***p***	***b***	***SE b***	***β***	***p***
	Learning & Development Score 1				**Learning & Development Score 2**			
Step 1								
Constant	3.74 (3.4–4.1)	0.18		<0.0001	3.68 (3.4-4.0)	0.13		<0.0001
GA-Rest ΔHR	0.009 (0.00–0.02)	0.004	0.50	0.016	0.10 (0.002-0.02)	0.003	0.57	0.005
Step 2								
Constant	3.57 (2.2–4.8)	0.62		<0.0001	3.37 (2.0-4.2)	0.42		<0.0001
GA-Rest ΔHR	0.008 (-0.003–0.02)	0.005	0.44	n.s.	0.008 (-0.002-0.02)	0.004	0.47	n.s.
BAS Drive	0.023 (-0.01–0.07)	0.022	0.16	n.s.	0.007 (-0.1-0.08)	0.03	0.05	n.s.
BAS Reward	-0.02 (-0.07–0.09)	0.036	-0.011	n.s.	0.018 (-0.03-0.10)	0.03	0.14	n.s.

Table 4: Regression analysis to determine the relationship between scores on the Learning and Development questions and change in heart rate in the group activity (GA-rest ΔHR) (Model 1). Change in HR in the group activity predicted significant variance in the scores on the Learning and Development questions at Time 1 and Time 2. A second model considered whether scores on BAS drive and reward moderated this relationship (Model 2). When the BAS variables were entered with change in HR in the group activity, the model was no longer significant for Time 1 or Time 2.

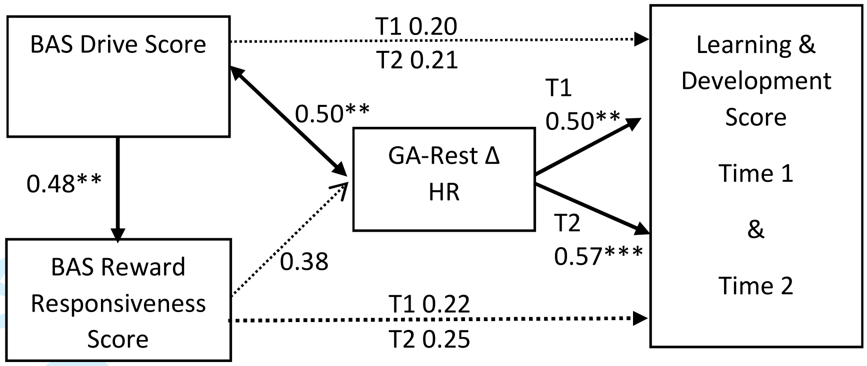

Figure 1: Path analysis demonstrating the relationship between scores on BAS (BAS drive and BAS reward responsiveness scores), change in heart rate in the group activity (GA-Rest Δ HR) and scores on the Learning and Development questions. Change in heart rate during the group activity predicted variance in Learning and Development scores at both time 1 and time 2. The BAS scores were highly correlated. While BAS reward responsiveness score (but not drive) predicted variance in heart rate change, neither BAS score significantly predicted variance in Learning and Development scores at either time 1 or time 2. Thus the relationship between BAS scores and learning appears to be related to their mutual dependence on change in heart rate during the group activity.

	Difficult Conversations HR	Communications HR	Group Activity HR
Resting HR	0.30 -0.14 0.57	0.20 -0.24 0.43	0.41* 0.04 0.70

Table 1: Correlation coefficients with 95% confidence intervals describing the relationships between resting heart rate and heart rate during each critical incident

$*p<0.05$, $**p<0.01$