

The science of leadership and implications for leadership development in a more complex world

Introduction

This special issue focusses on a promising new avenue for leadership development, which incorporates the application of behavioural science in the development of leadership skills. This new avenue is of particular interest since a better understanding of the relationship between the behavioural sciences, particularly neuroscience, and leadership behaviour could form the basis for equipping executives to have a better grip on dealing with the complexities currently facing them in their dynamic world environment. This special issue follows the successful Ashridge conference entitled “Scientific Advances in Developing Leaders for our Complex Environment”.

Since the 1950s and the dominance of behaviourism, much of research in the management arena has focussed primarily on observable behaviour and competence development (Armandi *et al.*, 2003; McCauley and Van Velsor, 2004). This special issue, however, argues that academics and practitioners alike should be looking beneath this surface behaviour to the cognitive, physiological, psychological, and neurological processes that subconsciously drive our thought processes and influence our behaviour. We argue that applying insights from the disciplines of cognitive psychology and neuroscience to the field of organisational psychology has the potential to transform our understanding of how leaders operate and inform new approaches to developing the capacities our leaders will need to succeed in our complex environment.

This introductory paper provides a brief analysis of the issues facing leaders and leadership development in the above context, then presents the five papers especially written for this special issue along with a conclusions section and finishes with a section on new directions for further research in the area.

The twenty-first century environment and implications for leaders

Since the turn of the century the world in which leaders operate has changed significantly. Technological advances have broken down borders, reduced costs, increased access to markets for even the smallest of firms, and resulted in an increasingly competitive climate (Adler and Kwon, 2002; IBM, 2010). The World Economic Forum in 2016 predicted that there is an exponential growth of new technologies which will result in a Fourth Industrial Revolution, of a scale, scope and complexity unseen before, which will transform the way people work, leaders lead, and organisations operate (Schwab, 2016). These advances, along with developing and declining economies, political instability, increases in nationalistic and isolationist policies, advancing social media, climate change, and migration, are but a handful of the changes now apparent in our volatile, uncertain, complex and ambiguous (VUCA) environment.

It is argued by practitioners and academics alike that to cope with this changing global business arena, future leaders need to engage in more strategic and systems thinking, work more collaboratively, and be better able to manage and lead through ambiguity and change (Centre for Creative Leadership (CCL), 2011). For example, a McKinsey report proposed four challenges that leaders must now navigate to be effective in this changing environment: Leading in an age of upheaval including an ability to cope with the pace and the new context for leadership; mastering today’s personal challenges particularly how to



stay physically and mentally fit; dealing with the public face of leadership, in particular the ability to communicate and connect with people; and decision making under uncertainty, including ensuring those around leaders are able to challenge and air multiple perspectives (Barton *et al.*, 2012).

McKinsey's proposition finds support from both the practitioner and academic literatures. EDA, for example, also argue that critical thinking and the ability to recognise assumptions, evaluate alternatives, and draw valid conclusions is now considered the number one priority for executives (EDA Inc. and Pearson Education Inc., 2011). The academic literature indicates the requirement for similar competences for leading in the twenty-first century. In his conceptual paper exploring the potential for action learning in promoting collaborative leadership, Raelin (2006) suggests a critical skill for leaders is to develop the capacity to collaborate with others including effective interpersonal skills, and the ability to consider and evaluate alternative perspectives. The capacity for resilience including thinking under pressure, adapting to new contexts and enhanced focus is also posited as important by Margolis and Stoltz (2010), whilst Marion and Uhl-Bien (2001) through the application of complexity theory to leadership in organisations, concur that leaders now require the capacity to survive and thrive in complexity with its associated uncertainty and ambiguity (Marion and Uhl-Bien, 2001).

Taken together the literature discussed suggests that in order to lead effectively in our complex environment leaders need to work more collaboratively, be able to think more critically, evaluate multiple perspectives, and develop the resilience to manage complexity and ambiguity.

Implications for leadership development

Meeting these changing demands on leaders requires continuous improvements in the quality and relevance of leadership development, and creates the obligation for academics and leadership development practitioners to develop new, innovative educational techniques that focus on the skills required in today's leadership landscape, and explore new avenues for increasing the effectiveness of management development (Grossman *et al.*, 2013). There is an imperative too for senior managers within organisations to recognise and understand the value of new approaches to leadership and the necessity of developing more relevant skills to prepare their organisations for the challenges of their environment.

In response to this need, this special issue explores the potential for research from cognitive psychology and neuroscience to develop our understanding of leadership and organisational behaviour as well as the process and experience of learning, and argues that in order to improve the practice of executive education academics and practitioners need to look beyond observable behaviour to the underlying cognitive, physiological and neuroscientific processes that determine that behaviour, facilitating the advancement of innovative methodologies that will develop leaders who can prosper in today's complex environment.

Neuroscience in particular, through developing our understanding of how our brain and nervous system influence our thoughts, feelings and behaviour holds important implications for understanding leadership and leadership development (Stuart, 2014). For example, neuroscientific research has revealed the malleability of our brains, and the impact that experience and learning new skills has on the neuroanatomy of our brains and the way in which our brains function (Yin *et al.*, 2003). We now know that experience, through the process of neuroplasticity, can increase the number of neural connections between cells, strengthening those connections and reshaping our brains, influencing both our current abilities and our perception of future experience (Lagrosen and Travis, 2015). Such insights have important implications for the "trainability", rather than inherent nature, of effective leadership and speak to the potential for leadership development to result in sustainable change.

Similarly, the theory of fight or flight, our physiological response to threat, triggered by our sympathetic nervous system when we encounter stressful situations has important implications for our ability to perform during, and learn from those situations (Kassam *et al.*, 2009), and as will be discussed by Waller *et al.* in this issue, may offer valuable insights into the potential for and limitations of incorporating challenging experiential simulations into leadership development programmes.

Row (2015) applies this threat response to leaders' capacity to lead change programmes within their organisations. She argues that change in organisations is perceived by the brain as a threat, a disconnect between what we know and recognise and our present conscious experience (Phelps, 2006). The uncertainty presented triggers the amygdala, which is responsible for processing emotion, and results in feelings of anxiety and concern. As discussed above, experience can shape our response to future experiences, and as such the anxiety triggered by change will be further compounded should the individual have previously encountered poorly executed change (Koyama *et al.*, 2005). Neuroscience also suggests that the stress induced by the loss of control engendered by change can also impact cognitive performance, particularly in the prefrontal cortex, compromising our ability to think and plan effectively (Mather and Lighthall, 2012). Row (2015) proposes, therefore, that in order to manage change effectively it is critical that leaders set realistic, achievable goals, offer options to provide the perception of control, and recognise and acknowledge the anxiety and stress experienced, which has been found to calm the amygdala's response to stress (Hassed, 2008).

Neuroscience also offers insights in terms of understanding our capacity for empathy and emotional intelligence, which research indicates occurs at a neural as well as cognitive level through the activation of mirror neurons. These neurons play a critical role in enabling us to understand other people's points of view, a skill which we evolved as a species in order to enhance our capacity to learn, to share skills, and ultimately to survive (Ramachandran, 2010; Gallese, 2001; Wicker *et al.*, 2003). Having neurons that respond to how others are feeling facilitates the sharing and communication of emotions, and has implications for leaders in terms of their ability to cascade emotions across the business, calm anxieties regarding change and encourage motivation, engagement and commitment in organisations (Nabben, 2015).

Moreover, Zhe and Yazdanifard (2015) argue that developing our understanding of the functions and influence of the various neurotransmitters in our brains might enable us to facilitate the production of beneficial neurochemicals and limit the production of less productivity-enhancing chemicals in order to engage and motivate employees and increase productivity. Dopamine, for example, is associated with the pleasant feelings of reward, the production of which encourages increased engagement in the reward producing behaviour and therefore could be manipulated to motivate employees (Wise and Prompre, 1989). Similarly, oxytocin is associated with trust, empathy and cordiality, and can be stimulated through physical touch or observation of caring behaviour (Carter, 2003). As such, developing trust and cooperative behaviours within teams could be facilitated through modelling caring, relational behaviours (Harari-Dahan and Bernstein, 2014). The implication for leadership development here is the potential to inculcate the understanding in our leaders of the neurochemical basis of the value of such behaviours in order to encourage them to behave in ways that will induce the release of productivity-enhancing chemicals and promote employee engagement, motivation, and collaboration.

The application of these insights to leadership development offers valuable potential in terms of helping leaders respond effectively to the uncertainty presented by our VUCA environment, and helping them to lead their employees through the change programmes that will be required in order for organisations to remain agile. Waldeman *et al.* (2011) in agreement with Senior *et al.* (2011) argue that a collaboration between neuroscience,

behavioural and management expertise is necessary to apply this multi-disciplinary research to leadership development. Identifying the neurological basis of leadership and organisational behaviour offers the potential for us to develop methodologies and strategies to train the brain for better performance, and to develop the capacities required for leaders to thrive in our complex and uncertain environment.

Introduction to our collection of papers

The papers in this special issue add to the research explored above and address some of the challenges and opportunities outlined through conceptual and empirical exploration of the insights afforded by research from the disciplines of cognitive psychology and neuroscience as well as organisational psychology, responding to Waldeman *et al.*'s (2011) call for a synthesis of research from multiple disciplines. Our first paper, "Experiential learning as preparation for leadership: an exploration of the cognitive and physiological processes" by Lee Waller, Megan Reitz, Eve Poole, Patricia Riddell, and Angela Muir pays attention to the specific methodology of experiential learning and considers the value of learning through experience in terms of preparing leaders for the challenges presented by our complex and volatile environment.

Through a discussion of the current literature the authors argue that a critical factor in the impact of experience on lasting learning is emotion, and whilst evidence suggests that both positively and negatively charged emotional experiences are impactful, the authors argue that it is the intensity of the emotion that results in long-lasting learning. They support this argument by reference to research from the field of neuroscience which explores the physiological basis of our stress response and the positive impact that this can have on our cognitive performance and ultimately learning, as proposed by Kassam *et al.* (2009) above. The authors argue, through their research, that by inducing the stress response, leadership development that incorporates emotionally charged experiential methodologies should result in learning that is long-lasting.

Their research with 28 participants who wore heart rate variance monitors to provide a measure of stress response did indeed find a significant correlation between change in heart rate and self-reported learning, irrespective of personality type. The authors argue that in order to develop leaders to cope with the challenges of our increasingly complex environment and to help them respond more effectively under stress, leadership development ought to incorporate stretching and challenging emotionally laden experiential learning. As such their findings offer a means through which we might develop the resilience and capacity to respond to change and complexity that Barton *et al.* (2012) CCL (2011), and Margolis and Stoltz (2010) suggest is vital to thriving in the VUCA environment.

Patricia Riddell too provides illuminating insights into the workings of the human brain in her paper "Reward and threat in the adolescent brain: implications for leadership development". This conceptual paper explores the key developmental changes in the adolescent brain and the neurological differences between the brains of mature and young adults. Specifically, Riddell's paper discusses the maturation of the areas of the brain responsible for reward and threat detection and response, and for the regulation of those responses and the implications of an imbalance in these areas for adolescent decision making, risk taking, emotion regulation and leadership.

Through critique of the current literature her paper explores the potential for the development of these areas to be accelerated by leadership development practices, particularly those that expose young adults to the decision making required of leaders, thus reducing risk taking behaviour, enhancing emotional regulation and increasing fast decision-making processes. Her paper offers a variety of developmental approaches that she hypothesises may be valuable ways of enhancing sensitivity to risk, increasing inhibitory

behaviours, developing fast, shortcut decision-making processes, and motivating young adults through reward, and as such developing the decision-making capacities argued by Barton *et al.* (2012), Raelin (2006) and CCL (2011) to be critical to operating in today's complex environment.

Riddell argues that today's flatter organisational structures and more collaborative approaches to leadership necessitate the development of leadership skills at all ages and career stages. Furthermore, understanding the differences in employee attitudes, motivations and skills is critical to the effective leadership of this generation of the workforce.

In his conceptual paper "A proposed new psychological model for judgment and decision-making: integrating the tri-partite model with hemispheric difference", Christopher Wray develops Patricia Riddell's discussion of the dual-processing theory which distinguishes between System 1, fast thinking (lacking in the adolescent brain) and System 2, slow thinking processes. Building on this theory, Wray proposes a tripartite model of cognition distinguishing between slow thinking, fast thinking, and reflective thinking, the last of which incorporates one's beliefs, goals, and broader knowledge and involves critical analysis and evaluation of alternatives, exploration of one's assumptions, a willingness to challenge one's beliefs, and tolerance of ambiguity.

Through discussion of the neurological literature, Wray draws parallels between the tripartite model and the distinction between the right and left hemispheres of the brain. Slow thinking, he argues, is promoted by the narrowly focussed left brain, as well as elements of the right hemisphere which is more open to ambiguity and uncertainty, integrating alternatives and attending to context. Reflective thinking, however, requires communication between the two and the prompting of the right hemisphere to access the left in order to examine the detail necessary to critique alternative solutions.

In support of the arguments presented above by Barton *et al.* (2012), Raelin (2006) and CCL (2011), Wray proposes that reflective thinking is vital to effective decision making in today's complex environment where outcomes are uncertain, and myriad alternatives and perspectives need to be incorporated into decision-making processes, a requirement galvanised by the increasing preponderance of shared leadership in the service of managing complex interdependencies.

Offering an approach to developing these skills Wray argues that an understanding of the neurological and cognitive components of these decision-making processes has significant implications for leadership development through the incorporation of reflective thinking into individual and organisational decision making – the vigilance to engage slow thinking, to consider and incorporate alternative frames, and attend to one's assumptions and beliefs – enhancing leaders' capacity for logical reasoning, analogic reasoning, tolerance of ambiguity, and shared meaning making.

Whilst Waller *et al.*, Riddell and Wray explore ways of incorporating neuroscientific findings into the practice of leadership development, our fourth paper, "Organizational cognitive neuroscience – potential (non-) implications for practice" by Michael Butler, introduces caveats to this position by consideration of both the potential and the limitations of an interdisciplinary approach to leadership development. Butler's conceptual paper explores the challenges inherent in applying learning from neuroscientific theory to practice. He considers the theoretical advances offered by organisational cognitive neuroscience (OCN) to knowledge and understanding of the process of decision making and discusses the capacity, or lack thereof, for both academics and practitioners to apply this learning to the understanding of the development of individuals and organisations.

Butler's definition of OCN is drawn from social cognitive neuroscience which applies understanding of the processes of the human brain to the study of social relations. As Butler explains, OCN in turn focusses this understanding on behaviour in the organisation setting, be that individual, organisational, or societal (Butler and Senior, 2007) whilst emphasising

the cross-disciplinary approach whereby theory and methods from OCN contribute to both organisational and cognitive neuroscientific knowledge.

Through presenting key examples of neuroscientific and physiological research the author argues that, whilst there is clearly potential for OCN research to deepen our understanding of the processes implicit in leadership and organisation behaviour which may be of value to leadership development, there is a real challenge to the application of OCN to practice from both types of research methods used. The authors argue that if the true potential for OCN research to be applied in LD settings is to be realised a consensus needs to be arrived at to encourage deeper engagement in the findings, to find an appropriate balance between commercial application and the ethical dilemmas presented, and to bring together both the disciplines and academics and practitioners.

This concern is reflected too in our final paper which draws attention to the potential disconnect between academics' and practitioners' perspectives in terms of the value of leadership development, and presents a challenge to the implementation of these insights and how this limits the true potential for leadership development to develop individual and organisational behaviour. In their empirical research paper "Does strategic leadership development feature in manager's responses to future HRM challenges? Riitta Viitala, Susanna Kultalahti, and Hilpi Kangas argue that as key stakeholders in the role, influence, alignment and impact of leadership development, it is imperative that senior managers recognise the potential for leadership development to support the development and implementation of organisational strategy and to help organisations meet the challenges of the future.

The authors argue that in order to deliver effective and impactful development, leadership and leadership development ought to be perceived as a strategic resource, and warn against the individualist perspective of leadership development which focusses primarily on the development of individual competences rather than the collective role of leadership within organisations, supporting Higgins *et al.*'s (2017) call for a more collaborative approach to leadership. As such the focus of their research paper is on understanding the perspectives of senior managers in regards to leadership and leadership development and whether or not these concepts are perceived to be strategically important alongside other pressing organisational issues. They explore this using a novel inductive approach which allows them to qualitatively explore over 700 leaders' perceptions of future HRM challenges and how these can be met.

The findings of their research suggest that senior leaders and HRMs do in fact perceive leadership as an individual capacity, emphasising a heroic leader, trait approach, and make very few connections between leadership development and organisational strategy. The authors argue that this indicates that senior leaders and HRMs in organisations do not consider leadership development to be an important strategic tool to support organisations in managing the challenges of the future, and as such may be blockers to the incorporation of the new approaches to leadership development that the insights explored in this special issue propose.

Conclusions and future research

Through this first article and the five papers presented in this special issue we have explored new avenues for addressing leadership development, which may be of particular importance in the context of the changing and increasingly complex and volatile nature of our environment.

The approach highlighted in this special issue has relevance to the argument presented in the literature discussed in the introduction that this VUCA environment presents a special need for a different set of skills for leaders that move away from the individualist and heroic theories of leadership, to a more collaborative approach (Raelin, 2006;

Higgins *et al.*, 2017). They require the development of capacities to think more strategically and critically, to evaluate multiple perspectives (Barton *et al.*, 2012; EDA Inc. and Pearson Education Inc., 2011; Raelin, 2006; CCL, 2011), and to develop the resilience and insight leaders need to manage the complexities of our changing world and engage and motivate our multi-generational workforce through often perpetual change (Barton *et al.*, 2012; Margolis and Stoltz, 2010; Row, 2015).

We have proposed that in order to develop these skills and better prepare leaders to lead, leadership development approaches need to develop too, and through the research explored in this special issue we have offered ways forward which speak to the value of understanding the physiological, neuroscientific, psychological and cognitive processes which lie beneath and inform the surface behaviours through which leaders lead, whilst being mindful of the challenges inherent in applying such research to the practice of leadership development.

Future directions

The application of behavioural science, particularly neuroscience, to the practice of leadership and leadership development is still in its infancy, and there are myriad avenues to explore that could offer further, valuable insights and build on the research we have discussed.

Future research would do well to test and develop the hypotheses explored in the conceptual papers presented in this special issue, for example, building on the conceptual work of Patricia Riddell through exploration of the impact of leadership styles which are designed to respond to the different stages of maturation of the decision-making centres of the brain on the engagement, motivation and development of different generations in the workforce. Similarly, in his conceptual paper Wray offers various interventions and prompts which he predicts will encourage reflective thinking and help us to avoid the pitfalls presented by our tendency to automatically apply heuristics, short-cuts, and biases in our decision making. These hypotheses warrant further investigation through future research to test the impact on individual and group decision-making processes as well as the impact on the effectiveness of those decisions and the performance of the leaders who make them in different contexts.

Furthermore, our ability to operate in this increasingly global market place which requires virtual interaction and cross-cultural collaboration might benefit from an exploration of the application of these various findings using virtual platforms and in different geographies and cultures.

The research explored in this paper also speaks to the potential for understanding more about the neurochemicals associated with different outcomes such as trust and reward (Zhe and Yazdanifard, 2015). Further exploration might seek to assess whether or not relational and caring practices do indeed increase production of oxytocin and whether such practices are associated with improved levels of trust and emotional intelligence and consider how to apply these insights to leadership development. Similarly, how might we induce the release of dopamine, associated with reward through the way that we either lead others or develop our leaders in order to maximise performance and learning? Research here might look to test the impact of incorporating reward or competition into leadership practices and development programmes.

There are also insights that might be developed through collaboration between management science and developmental psychology. For example, we now understand that cognitive development does not stop in early adulthood, and that we continue through stages of mental development throughout our adult lives (Dixon and Cohen, 2003). With each developmental step, we are able to make better sense of our world, adapt faster, identify patterns, arrive at more complex solutions, and are better able to deal with change

(McGuire and Rhodes, 2009). Future research might help us to develop learning interventions which accelerate this vertical development and enhance our capacity for critical and strategic thinking.

Future research needs also to help to bridge the gap between academia and practice and to demonstrate the value of applying insights from behavioural science to management development. Hard hitting, stretching learning interventions that manipulate our stress response as described in Waller *et al.*'s research can be difficult to sell to the C-Suite. As such, research that compares over time the impact on learning and the sustainability of traditional approaches with those that incorporate insights from neuroscience might provide valuable, scientific evidence to convince HR, L&D professionals and senior executives of the added value of more novel approaches to developing their leaders.

In their papers, both Butler and Viitala *et al.* talk of the differing pace of translational activity between academics and practitioners. Therefore, as well as providing evidence of the impact of scientific-based approaches, future research should take a more collaborative approach to the dissemination of research facilitating the application of academic findings to practice. Butler offers two examples of relevant institutions: the Behavioural Insights Team dedicated to the application of behavioural sciences, and BBC Radio 4's "The Human Zoo" which is a collaboration with Warwick Business School. IEDP, who promote the latest research and thought leadership developed by universities and business schools to a corporate audience, is another example, as is the Corporate Research Forum whose focus is on the practical application of research from people management, learning and organisation development. We would also argue that collaboration with such institutions ought to be achieved during the development and conduct of research as well as the dissemination, drawing together practitioners from industry with scholars from different disciplines in the design and scoping of research in order to ensure, from the outset, that the research is immediately relevant to practice, and identify from the start how the findings will be applied in organisations.

As well as developing understanding therefore, we would argue that future research needs to enable us to demonstrate the value, relevance and practical applicability of this understanding to leadership development. What is critical is that the disciplines of neuroscience and cognitive psychology are regarded as providing valuable insights, rather than simply a novel lens through which to consider leadership and leadership development. Research therefore needs to demonstrate that understanding more about our physiology, about what subconsciously drives our thought processes and chemically influences our behaviour can lead to the development of organisational practices and leadership development processes that, we would argue, have the potential to advance the way that we lead, and to enhance our capacities to survive and thrive in our ever changing, complex environment.

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References

- Adler, P.S. and Kwon, S.W. (2002), "Social capital: prospects for a new concept", *Academy of Management Review*, Vol. 27 No. 1, pp. 17-4.
- Armandi, B., Oppedisano, J. and Sherman, H. (2003), "Leadership theory and practice: a 'case' in point", *Management Decision*, Vol. 41 No. 10, pp. 1076-1088.
- Barton, D., Grant, A. and Horn, M. (2012), "Leading in the 21st century", *McKinsey Quarterly*, June, available at: www.mckinsey.com/insights/leading_in_the_21st_century/leading_in_the_21st_century (accessed 5 January 2015).

- Butler, M.J.R. and Senior, C. (2007), "Toward an organizational cognitive neuroscience", *Annals of the New York Academy of Sciences*, Vol. 1118 Nos 4-5, pp. 1-17.
- Carter, C.S. (2003), "Developmental consequences of oxytocin", *Physiology and Behavior*, Vol. 79 No. 3, pp. 383-397.
- Centre for Creative Leadership (CCL) (2011), "Future trends in leadership development: a white paper", available at: insights.ccl.org/wp-content/uploads/2015/04/futureTrends.pdf (accessed 10 May 2015).
- Dixon, R.A. and Cohen, A. (2003), "Cognitive development in adulthood", in Lerner, R.M., Easterbrooks, M.A. and Mistry, J. (Eds), *Handbook of Psychology*, Vol. 6, John Wiley & Sons, Inc., Hoboken, NJ, pp. 443-462.
- EDA Inc., and Pearson Education Inc. (2011), "2011/2012 Trends in executive development: a benchmark report", available at: <http://us.talentlens.com/news/2012-executive-development-trends-report-released> (accessed 15 January 2015).
- Gallese, V. (2001), "The 'shared manifold' hypothesis: from mirror neurons to empathy", *Journal of Consciousness Studies*, Vol. 8 Nos 5-7, pp. 33-50.
- Grossman, R., Salas, E., Pavlas, D. and Rosen, M.A. (2013), "Using instructional features to enhance demonstration-based training in management education", *Academy of Management Learning and Education*, Vol. 12 No. 2, pp. 219-243.
- Harari-Dahan, O. and Bernstein, A. (2014), "A general approach-avoidance hypothesis of oxytocin: accounting for social and non-social effects of oxytocin", *Neuroscience and Biobehavioral Reviews*, Vol. 47, November, pp. 506-519.
- Hassed, C. (2008), "Mindfulness, wellbeing and performance", *Neuroleadership Journal*, No. 1, pp. 53-60.
- Higgins, J., Reitz, M. and Williams, C. (2017), "The hero is dead... long live the new hero", in Fleming, K. (Ed.), *Inspiring Leadership*, Bloomsbury, London, pp. 67-79.
- IBM (2010), "Capitalizing on complexity: insights from the global chief executive officer study", available at: www-304.ibm.com/businesscenter/cpe/download0/200422/ceostudy_2010.pdf
- Kassam, K.S., Koslov, K. and Mendes, W.B. (2009), "Decisions under stress: stress profiles influence anchoring and adjustment", *Psychological Science*, Vol. 3 No. 2, pp. 1394-1399.
- Koyama, T., McHaffie, J., Laurienti, P. and Coghill, R. (2005), "The subjective experience of pain: where expectations become reality", *Proceedings of the National Academy of Sciences*, Vol. 102 No. 36, pp. 12950-12955.
- Lagrosen, Y. and Travis, F.T. (2015), "Exploring the connection between quality management and brain functioning", *The TQM Journal*, Vol. 27 No. 5, pp. 565-575.
- McCauley, C.D. and Van Velsor, E. (2004), "Our view of leadership development", in Van Velsor, E. and McCauley, C. (Eds), *Handbook of Leadership Development*, Jossey Bass, San Francisco, CA, pp. 1-22.
- McGuire, C. and Rhodes, G. (2009), *Transforming Your Leadership Culture*, Jossey Bass, San Francisco, CA.
- Margolis, J. and Stoltz, P. (2010), "How to bounce back from adversity", *Harvard Business Review*, Vol. 88 Nos 1-2, pp. 86-92.
- Marion, R. and Uhl-Bien, M. (2001), "Leadership in complex organizations", *The Leadership Quarterly*, Vol. 12 No. 4, pp. 389-418.
- Mather, M. and Lighthall, N.R. (2012), "Both risk and reward are processed differently in decisions made under stress", *Current Directions in Psychological Science*, Vol. 21 No. 2, pp. 36-41.
- Nabben, J. (2015), "The art of influence: apply emotional intelligence and create time and space for thinking", *Development and Learning in Organizations: An International Journal*, Vol. 29 No. 1, pp. 3-6.
- Phelps, E.A. (2006), "Emotion and cognition: insights from the study of the human amygdala", *Annual Review of Psychology*, Vol. 57, pp. 27-53.
- Raelin, J. (2006), "Does action learning promote collaborative leadership?", *Academy of Management Learning and Education*, Vol. 5 No. 2, pp. 152-168.
- Ramachandran, V.S. (2010), "The neurons that shaped civilization", *TED Talk*, available at: www.youtube.com/watch?v=0pwKzTRG5E (accessed 25 September 2014).

- Row, S. (2015), "Effective leadership in times of change: understanding and leveraging of the brain's response", *ITE Journal*, Vol. 85 No. 7, pp. 40-41.
- Schwab, K. (2016), *The Fourth Industrial Revolution*, World Economic Forum, Geneva.
- Senior, C., Lee, N. and Butler, M. (2011), "Organizational cognitive neuroscience", *Organization Science*, Vol. 22 No. 3, pp. 804-815.
- Stuart, R. (2014), "Applying neuroscience", *Training Journal*, pp. 53-56.
- Waldeman, D.A., Balthazard, P.A. and Peterson. (2011), "Leadership and neuroscience: can we revolutionize the way that inspirational leaders are identified and developed?", *Academy of Management Perspectives*, Vol. 25 No. 1, pp. 60-74.
- Wicker, B., Keysers, C., Plailly, J., Royet, J., Gallese, V. and Rizzolatti, G. (2003), "Both of us disgusted in my insula: the common neural basis of seeing and feeling disgust", *Neuron*, Vol. 40 No. 3, pp. 655-664.
- Wise, R.A. and Rompre, P.P. (1989), "Brain dopamine and reward", *Annual Review of Psychology*, Vol. 40 No. 1, pp. 191-225.
- Yin, H.H., Mulcare, S.P., Hilario, M.R., Clouse, E., Holloway, T., Davis, M.I., Hansson, A.C., Lovinger, D.M. and Costa, R.M. (2003), "Dynamic reorganization of striatal circuits during the acquisition and consolidation of a skill", *Nature Neuroscience*, Vol. 12 No. 3, pp. 333-341.
- Zhe, J.W. and Yazdanifard, R. (2015), "The neuroscience of effective leadership; cultivation of a healthy corporate culture through neurochemicals", *International Journal of Management, Accounting and Economics*, Vol. 2 No. 6, pp. 584-594.

Further reading

- Blumer, B.D., Baldwin, T.T. and Ryan, K.C. (2013), "Communication apprehension: a barrier to students' leadership, adaptability, and multicultural appreciation", *Academy of Management Learning and Education*, Vol. 12 No. 2, pp. 158-172.
- Butler, M.J.R. (2008), "Neuromarketing and the perception of knowledge", *Journal of Consumer Behaviour*, Vol. 7 Nos 4-5, pp. 415-419.
- Elderman, G.M. (1993), *Bright Air, Brilliant Fire: On the Matter of the Mind*, Perseus Books, Oxford.
- Howard-Jones, P.A., Demetriou, S., Bogacz, R., Yoo, H.J. and Leonards, U. (2011), "Towards a science of learning games", *Mind, Brain and Education*, Vol. 5 No. 1, pp. 33-41.
- Lee, N., Senior, C. and Butler, M. (2012), "Leadership research and cognitive neuroscience: the state of this union", *The Leadership Quarterly*, Vol. 23 No. 2, pp. 213-218.
- Schultz, W. (2013), "Updating dopamine reward signals", *Current Opinion in Neurobiology*, Vol. 23 No. 2, pp. 229-238.
- Sutherland, I. (2013), "Arts-based methods in leadership development: affording aesthetic workspaces, reflexivity and memory with momentum", *Management Learning*, Vol. 44 No. 1, pp. 25-43.

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