



Review article

Leadership in dental biomaterials research

Jack L. Ferracane

Restorative Dentistry, Oregon Health & Science University, Portland, Oregon, USA

ARTICLE INFO

Keywords:

Dental biomaterials
Leadership
Academic dentistry

ABSTRACT

A leader in dental biomaterials, as in any other oral and dental science, could lead in other fields and may provide institutional leadership. Leadership can be learned and cultivated. In accepting the mantle of leadership, one takes on the responsibility to move the field or institution forward and ensure that the future remains in capable hands.

We all believe that we can recognize effective leadership when we see it, but, as acknowledged in other contributions to this series of articles, it is the product of a complex set of interrelated skills and attributes. Many have proposed definitions that are likely accurate in large part. There may be subtle differences in what is considered leadership when it comes to business or sports or science or some other profession. But the main traits of any leader are the same and we can truly begin to understand leadership by asking some specific questions and suggesting possible answers.

1. Context

In an attempt to define context within this article, I have searched for motivating quotes from famous people and included them where appropriate to emphasize important points. Those quoted may be people who are considered to have made a real impact in the world around them, or perhaps they just said something at the right time that others found interesting and likely useful. It is important to realize that these are not perfect people, and in fact some of them might not have even been considered great leaders, but that does not detract from their insight and ability to teach us. I struggled with how to make this article specific to biomaterials research, and frankly after quite some time, decided that this was not really important. A leader in biomaterials research could lead in other areas as well, and may provide institutional leadership. Why should we be limited? A true leader would never allow it.

One of my heroes while growing up, and still to this day, is Abraham Lincoln, the 16th President of the United States of America. A simple but very complex man, capable of amazing things when a country engaged in civil war most needed someone amazing. What kind of courage must it have taken to surround oneself with one's own political enemies as his closest advisors during a very tumultuous time? I suspect the answer to that is a great leader. This story is told in the excellent book "Team of Rivals. The Political Genius of Abraham Lincoln," by Doris Kearns Goodwin [1]. Lincoln once said: "Always bear in mind that your own resolution to succeed is more important than any other one thing." A person who is not driven, and resolved, to succeed cannot be a leader. But

these attributes alone do not make the person a leader.

2. Definitions

What is leadership? There are a multitude of definitions, but I think this simple definition is appropriate. *Leadership is the art of motivating a group of people to act towards achieving a common goal* [[2]]. This definition places a high level of importance on the leader to motivate others to achieve an important goal. Thus a leader is only a leader when others are involved. A leader has not succeeded if the group is not motivated to work together, even if at times they are not successful. As stated by Lao Tzu, considered the father of Taoism, "When the best leader's work is done the people say, 'We did it ourselves'" [[3]]. While this is likely true, the leader holds the ultimate responsibility, and must accept this fact, even knowing that they cannot truly be successful alone. I believe that there is also an "art" to leadership, and while it can be innate, it can also be learned and cultivated.

3. Motivation

Why do people lead? What is their motivation to do this? I believe that people lead in part to satisfy their egos, in part to address their altruistic yearnings, and in part to address a simple need to get something done. But it also may be instructive to remember what U.S. General Omar Bradley identified as essential qualifications of good leader: "the ability to recognize, select and train junior leaders." [4] When we take on the mantle of leadership in our field, we take on the

E-mail address: ferracan@ohus.edu.

<https://doi.org/10.1016/j.jdent.2019.05.013>

responsibility to move the field forward but, perhaps more importantly, to ensure that the future remains in capable hands.

4. Traits

What traits do leaders have? Some of the traits of a leader have been described as decisiveness, awareness, focus, accountability, empathy, confidence, optimism, honesty and inspiration [5]. Who would argue with any of these? Queen Elizabeth II of the United Kingdom was quoted as saying “*I know of no single formula for success. But over the years I have observed that some attributes of leadership are universal and are often about finding ways of encouraging people to combine their efforts, their talents, their insights, their enthusiasm and their inspiration to work together.*” [6] Are the qualities of leaders in a scientific discipline like biomaterials science similar to those in other disciplines and professions? The basic qualities are likely the same. Among other things, I think one of the key traits is dedication. Perhaps of even greater importance are commitment and determination. But surely a leader must also have a strong work ethic, some reasonable level of ingenuity and creativity, a general sense of caring and compassion, integrity, and a strong desire to do good things. Perhaps there is something else that is often overlooked and is of equal importance. Let’s call it the human factor. A leader must be able to recognize and admit when they are wrong, or have done something incorrectly. The fact that “nobody is perfect” seems often to be lost on many people, who idolise others in a way that is non-productive and unnatural. This sets up a situation that will almost always end in failure, likely of both protagonists. Therefore, in setting an example a true leader knows and understands their own limitations and owns their own mistakes. Further, they demonstrate comfort in this acknowledgement, and their confidence becomes increased rather than decreased as a result. As English statesman and former Prime Minister, Winston Churchill, said: “*Courage is what it takes to stand up and speak; courage is also what it takes to sit down and listen.*” [7] Our own inherent limitations facilitate another of the important characteristics of a true leader. We can refer to this trait as “shark mentality.” By this I mean the desire, will and fortitude to keep moving forward and learning new things, *i.e.* realising and admitting that there is so much more to be learned, and pursuing it always. That example provides the stimulus for the next leap in ideas in any field.

5. Legacy

While it is reasonable to argue that many people who claim to be leaders actually seem to demonstrate the antithesis of some of these attributes, most likely compassion and an honest desire to do good provides a barometer of their true success as a leader in every sense of the word. In the biomedical scientific disciplines, we expect that we strive mostly for the advancement of our field and the pursuit of new knowledge that in the best case results in improved quality of life for others. It would be naïve to think that most of the leaders in our field are complete altruists, and do not also have a strong desire to succeed for the purpose of achieving a high quality of life for themselves. But I think that a true leader really desires to leave a legacy, and that legacy is the next generation of leaders. As stated by Ralph Nader, the political activist, author, lecturer, and attorney: “*The function of leadership is to produce more leaders, not more followers.*” [8]

6. Motivation

We in biomaterials research exist in an environment that is rapidly and constantly changing. It is doubtful that many of the scientists who led our field a generation or two ago would have conceived of the current rate of introduction of new products, techniques and concepts to the world of oral healthcare. This makes it very exciting to be sure, but also puts greater demands on the leaders to be well grounded in the science, while also willing and capable of taking high risks for the

purpose of achieving high rewards. The death of an area of interest is no doubt sealed by complacency. As leaders, it is our duty to instill in our mentees the excitement for our work and the desire to move forward into the previously unknown. This defines science, and in the area of biomaterials, we are fortunate to be able to look out at an almost limitless horizon. As the theologian and Dominican Friar Thomas Aquinas said: “*If the highest aim of a captain were to preserve his ship, he would keep it in port forever.*” [9] Let’s always strive to head out to sea, not just for adventure, but to discover the next great thing.

7. Mission

What types of leaders are needed in a scientific field like dental biomaterials? We are tasked with the mission of advancing an exciting interdisciplinary science ultimately designed to improve the health of every individual. We do not do research to make better vacuum cleaners, paper cup dispensers, or autonomous driving vehicles, though all are worthwhile pursuits. Instead, we seek answers to complex problems that negatively affect the lives of our friends, our relatives, and the many we have yet to meet. While we are often deeply absorbed in our science, seeking answers within the most basic and fundamental aspects of materials and their interaction with the biological environment, it is important that we always consider that the practical advances we can make may end up improving someone’s overall health and healthcare experience. In other words, if we do it right, someone else benefits in a way that their quality of life is improved or their suffering is diminished. We can have an almost direct influence on making this happen, and we are provided with the opportunity to tell people about it. I think it is always good to be mindful of this. Science is a wonderful thing, and there is so much to be gained on a personal and community level in the art of scientific inquiry and experimentation. However, when the result is an idea that improves someone else’s life, so much the better.

8. Mentoring

Leaders, however, need to do more than just lead in the creation of new scientific information. Leaders need to be mentors, first and foremost. The key is to provide the appropriate level and timing of assistance that results in the mentee developing optimally, either by working on their own or within a team or most likely both. Mentoring in our profession requires role modeling and instruction in some very basic activities, such as making career decisions, writing strong and sound research proposals, conducting high quality scientific inquiries and writing quality manuscripts, giving impactful presentations to both basic scientists and clinicians, developing effective teaching skills (or even better, facilitative learning skills), providing thoughtful and accurate reviews of manuscripts and grants, serving as valued members of university committees or professional organizations and groups, *etc.* The leader helps by providing opportunities, guidance and appropriate feedback, while letting the mentee work their own path through each endeavor. Leading is not doing, but rather facilitating. There are numerous opportunities for mentees to “train” in these areas. Allowing a mentee to review a manuscript submitted to a journal (with the editor’s agreement) and then reviewing their critique with them provides a great learning opportunity. The same approach can be used for manuscript and grant writing. Inviting other scientists to experience and comment on a poster or oral presentation or lecture by the mentee, perhaps as a practice activity prior to the actual presentation at a meeting or classroom session, is invaluable. Perhaps it is even more impactful when the leader provides the opportunity for the mentees to critique the mentor’s presentation. Science does not move forward quickly when people, leader or mentee, do not avail themselves of constructive criticism. Another way to instill a great sense of worth and acknowledgement on one’s mentees is to promote them for service activities at the appropriate levels and at the correct time in their development. This will lead to continued growth and development, while

simultaneously imparting a sense of community and ownership.

9. Pathway

What is a reasonable pathway toward becoming a leader? Some people will become leaders by working their way through leadership courses and training programmes, with experts providing valuable tips and experiential opportunities to develop and hone skills. Others will be fortunate enough to be surrounded by leaders who provide them a daily dose of examples. All will be given the opportunities to develop these skills themselves. Some people need less help than others, but even those considered “born leaders” need guidance and training. When a person is becoming a leader, they begin to appear more confident, and not because they know everything (as noted above), but because they are unconcerned with not knowing everything. As stated by strategic advisor Michel Theriault: *“After all, leadership, whether you are a manager, president, or entrepreneur, isn’t just about telling people what to do, it’s enticing people to follow you and give it their all. Sometimes, you can do this best when you admit you can’t know everything.”* [10] As a scientist, this is not only a quality for a leader, but for anyone who wants to be successful. As soon as you start acting or believing that you know it all, you may as well quit. What more is there to learn if you know it all? If there is nothing left to learn, why continue to do research? It obviously makes so little sense that it becomes immediately apparent that the “smartest person in the room” is likely not the one who thinks they are. Remember that. I think this may have been said best by Abraham Lincoln: *“I do not think much of a man who is not wiser today than he was yesterday.”* [11] If we take the approach to learn something new every day, no matter who we are, that simple objective will pay huge dividends for a long time.

What is a good personal path to leadership? I don’t know the specific answer to this question, and I just assume that this will vary greatly from person to person. But if I had to recommend a strategy, it would be to observe others who are considered to be successful leaders in order to learn from them and emulate the behavior they demonstrate when leadership opportunities arise. It is unlikely that all of the desired skills will be evident in any one person. So find leadership everywhere you can, in every type of situation, whether it directly pertains to your advancement in biomaterials research or in some other discipline. Where you see success, ask how it happened? Ask who was responsible? Ask what they did to make it a reality? Be a scientist, not just at the laboratory bench or at the chairside or bedside, but everywhere. I realise as I look back upon my own career that I missed many opportunities to learn and grow. Had I taken more advantage of them at the time, might I be a more successful leader now? I really think that I would. I think that it takes time for many of us to get to the point that we can put aside our own ego and striving for acceptance and status, and instead acquiesce to being taught and guided by others. I think this quote from the writer Anthony J. D’Angelo is so apropos: *“You don’t have to hold a position in order to be a leader.”* [12]

10. Success

How is leadership success gauged? To my thinking, leadership success refers to the achievement of a goal through the efforts of others that were facilitated by the leader. As stated by the statesman Nelson Mandela: *“It is better to lead from behind and to put others in front, especially when you celebrate victory when nice things occur. You take the front line when there is danger. Then people will appreciate your leadership.”* [13] When I read this quote, I think that what Mr. Mandela meant by “leading from behind” was not that one should let someone else take

the forward position during the “battle”, keeping oneself safe from danger. But rather the leader puts others in front of him or herself when the time comes to celebrate the success of the achievement. And if there is failure, or danger, the leader stands in front and accepts the blame and criticism. This is how respect is earned. A true leader is respected. That is why he or she is able to lead.

In the world of biomaterials science, leadership requires the coordinated efforts of a multidisciplinary team that complement each other’s knowledge and expertise. In a complex field that crosses the boundaries of chemistry, materials science and biology, it is impossible for a single individual to know or do it all. The team is critical. But the team requires a leader to truly achieve at the highest levels. And it is only at the highest levels of achievement that the really big problems can be solved. We often hear the word “collaboration,” and in fact, it seems to me that it is an overused and often inappropriately used word. I think people use it to make the point that they really do seek the aid of others to answer big questions in their field. But words are pretty cheap. It is the actual doing that matters. A true leader does not seek collaboration for the sake of sounding like a “modern day” scientist, but in order to create, motivate and lead a diverse team that has the capacity for success. That is true collaboration, and it is measured by real outcomes. And part of being a leader is recognising what real outcomes are. I would encourage all the readers of this article to challenge their own opinion of themselves as current or future leaders. I know that writing it has given me pause, and I hope that while it has made me recognize my limitations, that I do not feel bound by them.

11. Tenacity

To close, I would like to circle back to one aspect of leadership that I noted previously and believe that I cannot overstate. I used the word determination to describe this quality, but tenacity may be even more appropriate. The fortitude to keep going in pursuit of something that is important is infectious, and easily is transferred to the leader’s team. I was awed by the words used in a speech by Mr. James Valvano, a university basketball coach who was receiving an award during the last days of his life, which was being taken from him by cancer. Here was a man who very publicly led young men in pursuit of sports excellence, succeeding at the highest level, but now faced his “final curtain.” Despite the overwhelming odds against him, he continued to lead right to the end by giving these simple instructions: *“Don’t give up. Don’t ever give up.”* [14] It is so easy to quit. But a true leader doesn’t quit. Carpe Diem!

References

- [1] Doris Kearns Goodwin, *Team of Rivals. The Political Genius of Abraham Lincoln*, Simon & Schuster, New York, 2005.
- [2] Susan Ward. Leadership Definition. What Is Leadership? And Can You Learn to Be a Good Leader? <https://www.thebalancesmb.com/leadership-definition-2948275>.
- [3] https://www.brainyquote.com/quotes/lao_tzu_151133.
- [4] <https://ssi.armywarcollege.edu/pubs/parameters/articles/1972/bradley.pdf>.
- [5] Sammi Caramela. 4 Ways to Define Leadership. <https://www.businessnewsdaily.com/3647-leadership-definition.html>.
- [6] https://www.brainyquote.com/quotes/queen_elizabeth_ii_461461.
- [7] https://www.brainyquote.com/quotes/winston_churchill_161628.
- [8] https://www.brainyquote.com/quotes/ralph_nader_110188.
- [9] https://www.brainyquote.com/quotes/thomas_aquinas_187122.
- [10] Michel Theriault. You Can’t Know Everything: How Admitting This Gives You Credibility (<https://www.forbes.com/sites/allbusiness/2014/09/18/you-cant-know-everything-how-admitting-this-gives-you-credibility/#152f18283c62>).
- [11] https://www.brainyquote.com/quotes/abraham_lincoln_101467.
- [12] https://www.brainyquote.com/quotes/anthony_j_dangelo_106368.
- [13] https://www.brainyquote.com/quotes/nelson_mandela_393048.
- [14] https://www.brainyquote.com/quotes/jim_valvano_358453.