Institution: University of Northampton		
Unit of Assessment: 5 – Biological Sciences		
Title of case study: Changing the Media Narrative and Public Understanding of the Beneficial Effects of Stretching		
Period when the underpinning research was undertaken: 2012 - 2018		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s): Tony Kay	**Role(s) (e.g. job title):** Professor	**Period(s) employed by submitting HEI:** 2005 – Present
Period when the claimed impact occurred: 2014 - 2020		
Is this case study continued from a case study submitted in 2014? No		

1. Summary of the impact

Professor Tony **Kay** has contributed to research on various forms of stretching and their acute and chronic impact on performance and injury risk. He has provided stakeholders in public health a new evidence-base for the efficacy of different types of stretching, and corrected the common misinterpretation of the negative impact of static stretching on performance and injury risk. Through broad public dissemination to international media (the BBC, New York Times, and the Guardian, among others), athletic governing bodies (Canadian Society of Exercise Physiology, American National Academy of Sports Medicine) and health bodies (NHS (National Health Services) England), **Kay** has promoted the positive impact of stretching and refuted previous incorrect negative assumptions. This has resulted in national and international health care bodies' best practice recommendations ensuring stretching is used within a warm-up routine.

2. Underpinning research

Tony Kay, Professor of Biomechanics at the University of Northampton, has conducted research on the neurological, neuromuscular, and mechanical properties of whole muscle and tendon structures following various types of stretching (the most common activity in sport and clinical physiotherapy practices). **Kay** has specifically examined their effect on force production, range of motion and injury risk, factors vital to athletic and clinical populations.

Kay has conducted the first systematic review examining the dose-response characteristics of the stretch-induced force-loss phenomenon **[3.1]**. This extensive review of over 100 studies, demonstrated that the detrimental effects of static stretching are limited to durations outside of the standard use patterns of both athletic and general populations. A comprehensive review was undertaken that clarified several misconceptions reported within the literature that influenced governing body recommendations and media coverage on the use and effects of static stretching.

A larger follow-up meta-analytic review by **Kay** compared the effects of the 3 most common types of muscle stretching; static, dynamic, and proprioceptive neuromuscular facilitation (PNF), on range of motion, performance, and injury risk **[3.2]**. **Kay's** research rectified the growing assertion in some areas that stretching did not reduce muscle strain injury risk. The review concluded that, contrary to previous assumptions, stretching had a protective effect against muscle strain injury, the most common injury in sport, as well as psychological benefits, such as making people feel better prepared for exercise, and when used in the correct (applied) dosage, did not decrease their physical performance **[3.3].**

Further research demonstrated that the most effective type of stretching is proprioceptive neuromuscular facilitation (PNF) stretching, which commonly results in greater increases in range of motion **[3.3, 3.4]**. PNF stretching involves holding the muscle in a stretched position and then performing alternating bouts of contraction and relaxation. Despite PNF's greater ability to increase range of motion, the practical limitation of needing a partner during the stretch limits its wider use. However, **Kay's** research clarified the misconceptions of the mechanism underpinning PNFs superior ability to increase range of motion **[3.4].** The name PNF is misleading as it assumes neuromuscular proprioceptors influence increased range of motion following this type of stretch. Using robust methods to examine potential neurological, neuromuscular, and mechanical mechanisms, **Kay** confirmed mechanical and neurological mechanisms, but not neuromuscular proprioceptors, were associated with the changes in range of motion [3.4]. This finding enabled **Kay** to develop, test and validate a novel form of PNF that was equally effective but removed the practical limitations of needing a partner **[3.5]**.

Kay has examined the mechanisms, developed novel forms of stretch to improve practicality, and identified common misconceptions on the impact of stretch on performance and injury risk within the literature published by the wider media to influence public perception and practice. The original research and comprehensive systematic reviews culminated in writing a Position Stand on stretching for the Canadian Society for Exercise Physiology **[3.6]**. **Kay** has called for an evidence-based approach to exercise guidelines related to stretching protocols, citing a paucity of high-quality studies in the field. **Kay's** research highlighted the common misinterpretation of the findings for athletic practice by researchers that has pervaded into mainstream media and public perception. Through the research discussed above, he has addressed these misconceptions and changed the understanding of stretching for a variety of stakeholders in public health, e.g., NHS.

3. References to the research

[3.1] Kay, A. D., & Blazevich, A. J. (2012). Effect of acute static stretch on maximal muscle performance: A systematic review. *Medicine & Science in Sports & Exercise®*, *44*(1), 154-164. https://doi.org/10.1249/MSS.0b013e318225cb27

[3.2] Behm, D. G., Blazevich, A. J., **Kay, A. D.**, & McHugh, M. (2016). Acute effects of muscle stretching on physical performance, range of motion, and injury incidence in healthy active individuals: a systematic review. *Applied Physiology, Nutrition, and Metabolism*, *41*(1), 1-11. https://doi.org/10.1139/apnm-2015-0235

[3.3] Blazevich, A. J., Gill, N. D., Kvorning, T., **Kay, A. D.**, Goh, A. M., Hilton, B., Drinkwater, E. J., & Behm, D. G. (2018). No Effect of Muscle Stretching within a Full, Dynamic Warm-up on Athletic Performance. *Medicine & Science in Sports & Exercise*, *50*(6), 1258-1266. [6]. https://doi.org/10.1249/MSS.0000000000001539

[3.4] Kay, A. D., Husbands-Beasley, J., & Blazevich, A. J. (2015). Effects of contract–relax, static stretching, and isometric contractions on muscle–tendon mechanics. *Medicine & Science in Sports & Exercise*, *47*(10), 2181-2190. https://doi.org/10.1249/MSS.0000000000000632

[3.5] Kay, A. D., Dods, S., & Blazevich, A. J. (2016). Acute effects of contract-relax (CR) stretch versus a modified CR technique. *European Journal of Applied Physiology*, *116*(3), 611-621. https://doi.org/10.1007/s00421-015-3320-8

[3.6] Behm, D. G., Blazevich, A. J., **Kay, A. D.**, & McHugh, M. (2016). Canadian Society For Exercise Physiology Position Stand on the Acute Effects of Muscle Stretching on Physical Performance, Range of Motion and Injury Incidence in Healthy Active Individuals. *Applied Physiology, Nutrition, and Metabolism*, *41*(1), Supplementary Appendix S8. http://www.csep.ca/view.asp?ccid=519

4. Details of the impact

Kay's research has helped to challenge the notion that static stretching durations used in athletic environments has detrimental effects and should be removed from warm-up practices, and clarified the dose-response effects of stretch and the maximum safe duration for stretching during warm-up. His research has also put to rest one of the most contentious issues and confirmed that static muscle stretching exercises can reduce the risk of muscle strain injury, the most common injury in sport. The research findings have been disseminated among key stakeholders leading to a change in both guidance and practice on the effects of stretch. These findings have also been propagated through international media, to increase public awareness of the benefits of this research.

Changing International Coverage and Promotion of Best Practices for Stretching

The dominant media narrative until recently has focused on studies reporting the potentially detrimental effects of static stretching before exercise including negative effects on performance and no injury preventative benefit **[5.1.1]**. Four of **Kay's** studies **[3.1 – 3.4]** and his Position Stand **[3.6]** have challenged this narrative and having been widely cited in the international media, changing media coverage of stretching practices in exercise, and increasing public understanding of the benefits of stretching and the different types of stretching. **Kay's** systematic review of the acute effects of several types of muscle stretching techniques on physical performance, flexibility, and injury prevention **[3.2]** has been cited in 35 news stories from 28 international news outlets including the *New York Times* **[5.1.2]** and *The Guardian* **[5.1.3]**. **Kay's** research on PNF stretching **[3.4, 3.5]** was highlighted in *Shape Magazine* **[5.1.4]**, bringing attention to the benefits of this type of stretching, something that was not widely known by the general public. His subsequent research **[3.3]** clarifies that there is no negative effect of several types of muscle stretching, when used within a full, dynamic warm-up on athletic performance. This has also been widely cited by 11 international news sources including the New York Times **[5.1.5]** and ABC Life **[5.1.6]**. For a more comprehensive list of media coverage see **[5.1.7]**.

Increasing Public Engagement with Motor Imagery Techniques

Kay clarified the misconceptions reported in the media about the negative effect of muscle stretching on muscle strength and further increased public awareness of ways to improve muscle strength through a study he conducted with the BBC 2's Trust Me I'm a Doctor programme based on his research, which had viewing figures of 2,300,000 **[5.2.1]**. The study looked at the possibility of increasing muscle strength simply by thinking about exercise (something called 'motor imagery'). The study directly impacted participants, who improved their muscle strength on average by 8% (with one participant increasing their strength by 33.9%). It introduced viewers to new scientific research on stretching and muscle strength in an accessible way. **Kay** produced two 'Think Yourself Stronger' audio-guides to complement the programme, which focused on lower and upper body strength. These are available to download free, increasing the public's access to these techniques **[5.2.2]**.

Impact on Stretching Protocol Guidelines for National and International Bodies

Kay's findings on the limited detrimental effects of static stretching for both athletic and general populations have helped clarify common misconceptions that were reported to the general public through the wider media. Prior to **Kay's** research, some governing bodies, such as The American College of Sports Medicine, recommended the removal of static stretching in warm-up routines due to the belief that it would cause performance impairments in strength-, speed- and power-related activities, and no injury preventative benefit. **Kay's** research has been instrumental in identifying the limitations within the research. His systematic and meta-analytical reviews have clarified the actual effects of stretch within a warm-up. His research has corrected previous misconceptions, provided evidence-based guidance to health bodies and has clarified for governing bodies and athletes misleading information that had previously been inconsistent.

This informed new Position Stands and public health guidance on previously contentious subjects:

- **England's National Health Service (NHS)** approached **Kay** to help develop, write and edit their NHS Choices health advice section on stretching and flexibility **[5.3.1]**. This guidance quotes **Kay**, "It is likely that durations of stretch used in the warm-up routines of most recreational exercisers produce negligible and transient reductions in strength." It further cites **Kay's** research reporting "the reduction in performance from pre-exercise stretching has been overstated." **[5.3.2]** This was the first guidance the NHS released on stretching and flexibility, and **Kay's** research was key to the development of their recommendations. According to a Freedom of Information Act request, the page has been viewed 62,061 times since November 2018 **[5.3.3]**.

- **The Canadian Society for Exercise Physiology (CSEP)**, Canada's leading authority in exercise science, focused on promoting research and evidence-based fitness, performance and health outcomes to all Canadians, approved and directly cites **Kay's** research in their first position stand on the topic that was co-authored by **Kay [3.6]**. The CSEP Chair states, "The recommendation in the CSEP Position Stand is that all components of a warm-up be included with appropriate duration of stretching. The inclusion of static, or Proprioceptive Neuromuscular Facilitation (PNF), stretching is recommended and has the potential to positively influence the standard warm-up routines of a large number of athletes." **[5.4]** This position stand has used **Kay's** extensive research to enable a change of position stand of CESP, which has informed the National Academy of Sports Medicine (NASM) in providing athletic guidance on how and why to stretch from the ACSM (American College of Sports Medicine).

The National Academy of Sports Medicine (NASM) in the United States, a leading authority in personal training certification worldwide, directly cites **Kay's** research **[3.1, 3.2]** in regard to best practices for stretching. **Kay's** research is used to inform the narrative including "static stretches of <45 seconds can be used in a pre-exercise protocol without significant decreases in "strength, power, or speed-dependent task performances" **[3.1]** and that "static stretching <60 seconds is considered an effective method for increasing joint range of motion (ROM), and is often thought to improve performance and reduce the incidence of activity-related injuries" **[3.2]**. NASM conclude that "Static stretching can be beneficial in many ways, such as correcting muscle imbalances, decreasing muscle hypertonicity, increasing joint ROM, relieving joint stress, improving the extensibility of the musculotendinous junction, maintaining the normal functional length of a muscle (length-tension relationships), decreasing the chance of injury and in turn enhancing power and strength." These recommendations use **Kay's** research to provide an evidence-based exercise prescription guide to the use of stretching within a warm-up **[5.5].**

5. Sources to corroborate the impact

[5.1] International Media Portfolio

[5.1.1] Search from 2000-2014 of New York Times articles demonstrating the negative reporting of the effects of stretching evident in the media. - https://www.nytimes.com/search?dropmab=true&endDate=20140101&query=static%20stretching&sort=best&startDate=20000101

[5.1.2] Gretchen Reynolds. "The Right Way to Stretch Before Exercise." New York Times, January 27, 2016, sec. Well. (cites **[3.2]**) - https://web.archive.org/web/20160127220856/http://well.blogs.nytimes.com/2016/01/21/stretching-back-to-the-past/.

[5.1.3] Amy Sedghi. "Five Ways to Improve Flexibility." The Guardian, February 23, 2020, sec. Fitness. (cites **Kay** directly) -

https://web.archive.org/web/20200813024640/https://www.theguardian.com/lifeandstyle/2020/feb/23/five-ways-improve-flexibility

[5.1.4] Caitlin Carlson. "The Stretching Technique You Haven't Heard of Yet." *Shape*, February 26, 2015. (cites **[3.4]**) - http://web.archive.org/web/20200426191215/https://www.shape.com/fitness/trends/stretching-technique-you-haven-t-heard-yet.

[5.1.5] Gretchen Reynolds. "To Stretch or Not to Stretch? Athletes Put It to the Test - The New York Times." New York Times, July 18, 2018, sec. Well. (cites **[3.3]**) - http://web.archive.org/web/20180801074757/https://www.nytimes.com/2018/07/18/well/stretch-exercise-warmup-athletes-stretching.html.

[5.1.6] Patrick Wright. "Do You Really Need to Stretch and Warm up before Exercise?" ABC Life, October 9, 2019. (cites **[3.3]**) - https://www.abc.net.au/life/do-we-really-need-to-stretch-and-warm-up-before-exercise/11275324.

[5.1.7] Portfolio of media coverage of **Kay's** research. (cites **[3.1-3.4]**)

[5.2] BBC 2 – Trust Me I'm a Doctor Summer Special Programme

[5.2.1] BBC email confirming Trust Me I'm a Doctor viewing figures

[5.2.2] Trust Me I'm a Doctor 'Think Yourself Stronger' audio-guides - https://www.bbc.co.uk/programmes/articles/1wzlc1KxyjMlk6ZMB0sQVhG/is-it-possible-to-get-stronger-just-by-thinking-about-exercise

[5.3] NHS Choices - Guidance on the use of stretching

[5.3.1] NHS email confirming **Kay's** involvement in developing and editing the NHS Choices health advice section on stretching and flexibility.

[5.3.2] NHS Guidance - Do I need to stretch before exercising? (cites **[3.1]**) - https://www.nhs.uk/live-well/exercise/stretch-before-exercising/

[5.3.3] FoIA Request (NIC-411258-N2Z5Q) to the NHS on number of website visits for 'NHS Guidance - Do I need to stretch before exercising?' webpage.

[5.4] CSEP Position Stand - Getting the most out of your stretching routine. The CSEP Chair's official approval of CSEPs first position stand on the impact of stretching. - https://www.csep.ca/view.asp?ccid=519

[5.5] NASM - Is Static Stretching the Best Strategy for Injury Prevention and Performance Enhancement? (cites **[3.1, 3.2]**) - https://blog.nasm.org/fitness/is-static-stretching-the-best-strategy-for-injury-prevention-and-performance-enhancement