

Title: Let's take the dog for a gait...

Introduction

Interesting title? You read the title and think... "What? Should it not be walk or run?" Seems logical and makes sense, "Let's take the dog for a walk" or "Let's take the dog for a run." One would not traditionally say "Let's take the dog for a gait." Then why, as researchers, scientists, and members of the academic community, have we allowed such ambiguous vernacular to become commonplace in our field of research - we may not say it, but we certainly write it.

Originally the ability to measure and record movement was so novel that the term "gait" may have been all-encompassing. As time and technology have progressed, we as researchers can distinguish between, and have developed clearer definitions of, the different ways in which humans and animals move, in particular to their desired form of locomotion. As a result, it is no longer enough to say "gait" alone, but to ensure incorporation of an identifier for the type of locomotion.

The Oxford English dictionary defines gait (n.1) as '*Manner of walking or stepping, bearing or carriage while moving, walk, step*'[1]. However, the growing heterogeneous taxonomy of the term "gait" in biomechanics research often leads to papers and/or studies using the term in a variety of different contexts. This is most commonly done with regards to using it to define a mode of locomotion (e.g. walk or run), as opposed to the pattern/s used to produce that locomotion. Given the evolution and adaptation of the term in the field of biomechanics, this editorial aims to address and provide recommendations on three fundamental questions; (1) When did scientists commence studying "gait" patterns in locomotion?; (2) How has the term "gait" been utilised previously?; and, (3) How should we, as a collective group of researchers, academics, scientists, and clinicians, utilise the term "gait" into the future?

"Gait" and its' origin

Eadweard Muybridge is widely viewed as a pioneer in locomotion research. Specifically, he was hired in 1872 by Leland Stanford to answer the question about "unsupported transit" in horses; i.e. the trot and gallop[2]. This work precipitated the use of photography to capture motion in detail that was not possible to see with the human eye. Muybridge extensively

studied both animal and human movement and compared different types of “gait” patterns. His work marked the beginning of what would become an extensive field in biomechanics and clearly distinguishes the difference between gait (the pattern) and locomotion (the movement).

The utilisation of “Gait.”

Over recent times, biomechanics studies and researchers have adopted the term “gait” to describe a mode of locomotion, often using it to replace the verb or noun that defines the task (i.e. walk/walking, run/running, sprint/sprinting). This is especially common in studies that provide biomechanical evaluations of walking; which appears to have become synonymous with “gait”. However, what cannot be gleaned from this substitution is the task being conducted (the form of locomotion). Furthermore, so entrenched is the ambiguity in using “gait” as a synonym of walk/walking that key textbooks on human biomechanics and “gait” analysis refer to the all-encompassing “human gait”. For example, even Perry et al.’s textbook, *‘Gait Analysis: Normal and Pathological function’* defines gait analysis as *‘a method for diagnosing the way people walk’*[3].

To assist in demonstrating this ambiguity, we have provided the following example:

Lower limb biomechanics of the hip, knee, and ankle were calculated during gait.

The term “gait” is being used to outline the task (the mode of locomotion), but what is this task? One cannot go outside for a “gait” or take the dog for a “gait”. Ultimately, gait is the pattern produced during a mode of locomotion. This is especially important as gait is not mutually exclusive to walking nor humans. “Gait during walking” or “walking gait” is a common analysis conducted in biomechanics research; however, when considering human locomotion, the gerund “walking” can be replaced with running, sprinting, stepping, crawling, or cruising, to name a few. Not to mention the various forms of animal locomotion, including trotting, galloping, and swimming; of which were some of the original subjects of locomotion research[2].

The use of “gait” as a synonym for walking is common in biomechanics literature. We recently conducted a non-systematic review of the full-length articles and short communications in the 2019 issues of “Gait and Posture” (from January to October –

volumes 67 to 74). Specifically, the three authors independently reviewed 379 titles within the issues and characterised the titles into one of three categories; category 1 – studies providing a quantifier for the mode of locomotion being studied – either as a verb or noun/gerund (e.g. walk/ing, run/ing); category 2 – locomotion described as “gait” and/or no accompanying quantifier; category 3 – not applicable (e.g. papers not explicitly addressing locomotion). A total of 219 titles were characterised as addressing locomotion and applicable for categorisation into categories 1 or 2. Of these, a total of 108 (49%) quantified the form of locomotion (e.g. walk/ing, run/ing) in the title, with 111 (51%) utilising the word “gait” without further clarification to describe the task. However, 67 of these manuscripts did go on to state the form of locomotion in the abstract.

Evaluation of the remaining 44 manuscripts revealed that 37 stated the form of locomotion within the manuscript in the study aims/hypotheses or methods; with 7 providing no indication on the form of locomotion.

Walking towards the future

We aim to provide this information to shed light on the heterogeneous nature around the use of the term ‘gait’ and encourage academics, clinicians, and scientists alike to consider the question - what is “gait” and what do we mean when we talk about “gait”?

All in all, it is time we become more literal in our definition of what we study and evaluate. We strongly encourage researchers in the field of biomechanics, in particular, those who investigate walking gait, to rise to the challenge and establish clearer reporting of the task they are studying and their use of the term “gait”. Ultimately, such a collaborative movement will aid in streamlining search strategies for appropriate research for academics, clinicians and scientists alike.

References

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2. Shimamura, A.P., *Muybridge in motion: Travels in art, psychology and neurology*. *History of Photography*, 2002. **26**(4): p. 341-350.
3. Perry, J., J. Burnfield, and J.M. Burnfield, *Gait Analysis: Normal and Pathological Function*. 2010: SLACK.

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