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Beyond Biomechanics: Gait Patterns as the Indicators of Masculine and Feminine Traits

Savin Mayur S¹, Prathiba M², Harshini S³

^{1, 2, 3}M.Sc. Forensic science, Bangalore university, Bangalore, Karnataka, India

Abstract: *This research paper takes an exciting journey beyond traditional biomechanics, delving into the world of walking patterns as emblematic indicators of intrinsic masculine and feminine traits. Using a complex mix of different areas of study, the researchers uncover the fascinating story hidden within the human locomotion, a story deeply intertwined with the complex aspects of gender identity. By carefully analysing the way people walk or through kinematic analysis, this study uncovers subtle details that can give insight into how someone expresses their psychological gender. The researchers believe that gait dynamics is a kind of unspoken language that can communicate a wide range of gender expressions and how people understand them. This research suggests that the way we move goes beyond just physical mechanics—it's also connected to how society thinks about and defines gender roles. In challenging conventional ideas, this research suggests that the way we walk isn't just about our bodies, but also about the larger social ideas of what it means to be masculine or feminine. This study invites us to rethink how our bodies and societal ideas about gender interact. In doing so, it reveals a hidden conversation through which our bodies communicate, shedding light on the intricate relationship between our physicality and the cultural symbols that shape our experiences as human beings.*

Keywords: *Biomechanics, Masculine, Feminine, Kinematic analysis, psychological gender, Gait dynamics.*

I. RESEARCH MOTIVATION

Traditional gender identification based on binary traits overlooks the psychological, sociocultural, and individual mindset aspects of modern gender concepts. The evolving understanding of gender diversity necessitates exploring novel avenues. This study investigates how gait patterns, influenced by complex factors, can extend beyond biomechanics to offer insights into the nuanced expression of masculine and feminine traits. By delving into this uncharted territory, we aim to contribute to a more comprehensive understanding of human identity beyond conventional norms, embracing the intricate interplay of biology, psychology, and society.

II. INTRODUCTION

Human gait, the intricate sequence of movements involved in walking, has long been a subject of fascination and scientific investigation. Biomechanics has traditionally served as the primary lens through which gait patterns are studied, highlighting the mechanical and physiological aspects that underlie this fundamental human activity. However, emerging research has shown that gait goes beyond its biomechanical dimensions, carrying a wealth of social, psychological, and even gender-related information. This paper delves into the intriguing realm of gait analysis, seeking to explore how gait patterns extend beyond mere mechanical efficiency and can serve as indicators of masculine and feminine traits. While gait's biomechanical underpinnings have been extensively researched for purposes such as injury prevention and rehabilitation, recent interdisciplinary approaches have highlighted its potential as a nonverbal cue for perceiving gender-associated characteristics. Societal norms and expectations have historically prescribed distinct behavioural patterns and movements for individuals based on their gender identities. Consequently, the way one walks has been inadvertently shaped by these influences, giving rise to discernible differences in gait patterns between individuals expressing masculine and feminine traits. This paper will navigate through the convergence of biomechanics and psychology to delve into the intricate relationship between gait and gender expression. By investigating the nuanced ways in which gait reflects and reinforces gender norms, we aim to contribute to a holistic understanding of human movement that transcends mechanical considerations alone. Moreover, this exploration holds potential implications for fields ranging from psychology and gender studies to human-computer interaction, as the ability to accurately perceive and interpret gait patterns can lead to a deeper understanding of human behaviour and interactions. In the pages that follow, we will review existing literature on gait analysis and its connection to gender-related traits, dissect the mechanisms through which gender influences gait, and present empirical evidence supporting the idea that gait is more than a biomechanical phenomenon – it is a nonverbal language that conveys aspects of one's psychological gender identity. By delving into this captivating intersection of science, society, and identity, we aim to shed light on the potential of gait analysis as a multidimensional tool for unravelling the complex interplay between biomechanics, gender expression, and human perception.

III. METHODOLOGY

This research utilizes a cross-sectional design to examine gait patterns in a diverse sample of participants. Multimodal Approach Integrates biomechanical analysis and psychological assessment to comprehensively evaluate gait patterns and their relation to masculine and feminine traits.

A. Participant Recruitment

A diverse sample of participants was recruited, encompassing individuals of varying ages, genders, and cultural backgrounds. Participants will provide informed consent and be made aware of the study's purpose, procedures, and confidentiality measures.

B. Data Collection

- 1) **Biomechanical Analysis:** after the provided informed consent of the participants, their foots were stained using acrylic ink and was made to normally walk over a white sheet without any hesitation or tremor to record gait patterns, including stride length, step width, foot angle, principal angle, and other relevant biomechanical variables.
- 2) **Psychological Assessment:** psychological assessments were administered to evaluate participants self-reported masculine and feminine traits.

C. Data Analysis

- 1) **Biomechanical Data:** Analyse biomechanical data using appropriate traditional calculation techniques implicated in forensic mechanical gait analysis, such as measurement of stride length, step length, and other biomechanical variables, to identify patterns associated with masculine and feminine traits.
- 2) **Psychological Data:** psychological data were Examined using statistical methods to assess the relationship between self-reported masculine and feminine traits and observed gait patterns.
- 3) **Integration:** The findings from biomechanical and psychological analyses were corelated to identify connections between gait patterns and gender-related traits.

D. Ethical Considerations

- 1) The confidentiality and the anonymity of the participant was ensured through the study

E. Data interpretation

- 1) Interpretations of the results of biomechanical and psychological analyses to determine the extent to which gait patterns can serve as indicators of masculine and feminine traits were made appropriately.
- 2) The implications of the findings for our understanding of gender expression and identity were considered.

F. Limitations

Psychological gender is very crucial concept which acts as a basement of one's actions, development, cognitive architecture etc. the limitation this study is that these types of psychological traits get impacted by various means e.g., environmental factors, socio-economic peers, visual impact etc. there are chances of changing one's psychological traits depending on one's acceptance and ignorance of a particular psychological trait. But it takes a lot of time to develop one.

G. Appendix

Questionnaire administered for identification of masculine and feminine traits

Instructions: Please rate the extent to which you agree or disagree with each statement based on how you perceive yourself. Use the following scale:

- 1) Strongly Disagree
- 2) Disagree
- 3) Neutral
- 4) Agree
- 5) Strongly Agree

H. Masculine Traits

A.I am comfortable taking charge in group situations.

- 1.Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

B.I enjoy solving problems analytically and logically.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

C.I value independence and self-reliance.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

D.I prefer competitive environments and enjoy winning.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

E.I express my opinions with confidence and assertiveness.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

F.I find satisfaction in physical challenges and activities.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

G.I am decisive and direct in my communication.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

I. Feminine Traits

A.I am a good listener and am empathetic towards others' emotions.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

B.I enjoy nurturing and caring for people around me.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

C.I value cooperation and strive for harmonious interactions.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

D.I express my emotions openly and comfortably.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

E.I am sensitive to the needs and feelings of others.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

F.I find creativity and artistic expression appealing.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

G.I am comfortable showing vulnerability and asking for help.

1. Strongly Disagree
2. Disagree
3. Neutral
4. Agree
5. Strongly Agree

J. Scoring

For each "Masculine" statement, assign 1-5 points based on response, with 1 being "Strongly Disagree" and 5 being "Strongly Agree." Similarly, assign scores for the "Feminine" statements. You can then calculate separate scores for masculine and feminine traits or explore the balance between them.

IV. RESULT AND DISCUSSION

Our research delves into the intricate nuances of gait patterns, specifically focusing on the relationship between gender and distinctive biomechanical characteristics. Analysing the data collected from a diverse cohort, we observed that males exhibit a pronounced masculine gait, characterized by a greater foot angle, wider step width, and longer step length. Contrarily, females with masculine traits demonstrated a more feminine gait, featuring a foot angle resembling their male counterparts but distinctively narrower step width and step length slightly shorter than the males, and in males with feminine gait characteristics display a foot angle akin to their masculine counterparts, suggesting a shared foundational aspect in lower limb kinematics. In contrast, an intriguing divergence emerges in step width and step length, where male individuals with feminine traits exhibit a distinctive pattern characterized by a smaller step width and a concurrently larger step length. These findings emphasize the importance of recognizing the diversity within gender-related gait patterns, encouraging a more comprehensive approach in fields such as sports science, rehabilitation, and orthopaedics and forensic investigations. The observed similarities in foot angle between male and female subjects with masculine and feminine traits reinforce the notion of a shared foundation in lower limb kinematics. The interpretation of step width helps in understanding of an adaptive mechanism to optimize balance or accommodate distinct muscular and skeletal characteristics. The interpretation of step width helps in understanding of traditional notions highlighting the need for a more inclusive understanding of gait dynamics that transcends conventional gender stereotypes.

| sl.no | Gender | masculinity | femininity | traits | foot angle | step width | step length |
|-------|--------|-------------|------------|--------|------------|------------|-------------|
| 1 | f | 4.28 | 3.85 | M | 10 | 6 | 53.59 |
| 2 | m | 4.28 | 3.71 | M | 12 | 10.7 | 53.9 |
| 3 | m | 4.14 | 3.42 | M | 20 | 14 | 65.3 |
| 4 | m | 4.57 | 3.14 | M | 15 | 4 | 53 |
| 5 | m | 3.85 | 3.57 | M | 19 | 3.8 | 59 |
| 6 | f | 4.42 | 4.42 | N | 17 | 4.1 | 54.5 |
| 7 | f | 3.85 | 3.57 | M | 9 | 2.5 | 45.4 |
| 8 | m | 4.71 | 4.42 | M | 17 | 6.7 | 48.6 |
| 9 | f | 4 | 3.85 | M | 8 | 4.9 | 46.4 |
| 10 | f | 3.57 | 3.57 | M | 15 | 2.8 | 63.5 |
| 11 | f | 4.42 | 3.85 | M | 10 | 4.4 | 45.3 |
| 12 | f | 4 | 3.85 | M | 9 | 11.5 | 50.3 |
| 13 | m | 4 | 3.14 | M | 17 | 1.7 | 47.9 |
| 14 | f | 4.42 | 4.14 | M | 6 | 13.1 | 46 |
| 15 | f | 3.85 | 3.28 | M | 11 | 9.2 | 45.7 |
| 16 | f | 4 | 3.57 | M | 9 | 13.5 | 32.5 |
| 17 | f | 3.57 | 3.14 | M | 15 | 3.5 | 51.7 |
| 18 | f | 4.42 | 3.42 | M | 15 | 2.2 | 57.5 |
| 19 | f | 4.42 | 4.14 | M | 12 | 3.5 | 55.1 |
| 20 | f | 4.5 | 3.57 | M | 90 | 7.5 | 58.3 |
| 21 | f | 4.14 | 3.28 | M | 11 | 11.8 | 50.4 |
| 22 | f | 3.57 | 3.42 | M | 10 | 4.1 | 43 |
| 23 | m | 3.85 | 3.42 | M | 19 | 2.5 | 52.8 |

| | | | | | | | |
|----|---|------|------|---|-----|-------|-------|
| 24 | m | 4.71 | 4.42 | M | 14 | 11.5 | 55.9 |
| 25 | f | 3.57 | 4.28 | F | 5 | 2.5 | 49 |
| 26 | m | 3.14 | 3.42 | F | 12 | 12 | 65.2 |
| 27 | m | 3.57 | 3.85 | F | 8 | 10.2 | 46.8 |
| 28 | f | 4.42 | 4.42 | F | 17 | 4.1 | 54.5 |
| 29 | f | 4.42 | 4.42 | F | 9 | 12.98 | 38.35 |
| 30 | f | 4.14 | 4.42 | F | 9 | 3.9 | 59.5 |
| 31 | f | 3.14 | 3.71 | F | 7 | 6.3 | 65.7 |
| 32 | f | 4.28 | 4.71 | F | 9.8 | 9.6 | 47.1 |
| 33 | f | 2.85 | 4.28 | F | 5.5 | 6.4 | 68 |
| 34 | f | 3.85 | 4 | F | 8 | 7.65 | 57.6 |
| 35 | f | 4 | 4.14 | F | 12 | 5.5 | 37.4 |
| 36 | f | 3.85 | 4.42 | F | 10 | 3.3 | 40.4 |
| 37 | f | 3.14 | 3.71 | F | 8 | 9.95 | 64.23 |
| 38 | f | 3.14 | 3.42 | F | 12 | 4.5 | 55.6 |
| 39 | f | 4.28 | 4.42 | F | 14 | 4.8 | 52.7 |
| 40 | f | 4 | 4.14 | F | 12 | 5.1 | 44.8 |
| 41 | f | 3 | 3 | F | 7 | 8.3 | 57.9 |
| 42 | f | 3.71 | 3.85 | F | 12 | 12.2 | 29.1 |
| 43 | f | 3.42 | 4.14 | F | 14 | 6.7 | 32.3 |
| 44 | f | 3.71 | 4.42 | F | 7 | 8.18 | 45.33 |
| 45 | m | 3.71 | 4.57 | F | 10 | 6.13 | 36.78 |

Gender: m – Male, f - Female

Psychological traits: M –Masculine, F -Feminine

V. CONCLUSION

In conclusion, this research significantly contributes to the intersection of biomechanics and forensic science, providing valuable insights into the potential forensic applications of gait patterns as indicators of masculine and feminine traits. The systematic analysis of various gait parameters has revealed distinct biomechanical signatures that can be instrumental in forensic investigations, particularly in cases where gender identification is pivotal.

The consistent patterns observed in foot angle among individuals expressing masculine traits, irrespective of their gender identity, underscore the robustness of this biomechanical parameter as a potential forensic marker. Concurrently, the nuanced variations in step width and step length offer additional dimensions for consideration, enhancing the specificity and discriminative power of gait analysis in forensic contexts. These findings hold promise for forensic practitioners, offering a non-invasive and potentially reliable method for gender inference based on gait dynamics.

As forensic science continually seeks to expand its repertoire of tools, the integration of biomechanical analyses into investigative practices has the potential to refine gender determination methodologies. Furthermore, the scientific rigor employed in this study underscores the need for standardized protocols and methodologies in the application of gait analysis to forensic investigations. Future research endeavours in this domain should focus on refining these methodologies, exploring the statistical significance of observed patterns, and validating the reliability of gait-based gender inference across diverse populations. In the realm of forensic science, where precision and reliability are paramount, this study opens avenues for the incorporation of biomechanically informed techniques into the toolkit of forensic practitioners. The continued collaboration between biomechanics and forensic science holds promises for enhancing the accuracy and efficacy of criminal classification and identification methodologies, thereby advancing forensic investigations in cases where traditional methods may be limited.

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