On the use of gender as a variable in Computer Graphics research

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My focus is on examining the current use of a specific demographic variable (gender) in the context of Computer Graphics research. I will argue that (1) its use is a product of unscientific assumptions; (2) it is not currently rigorously defined and thus its use is harmful to research replicability; (3) its current use excludes a significant subset of the human population and contributes to their ongoing prosecution, discrimination and opression, thus going against ACM SIGGRAPH's Vision of *enabling everyone to tell their stories*; and (4) its current use can be easily modified to not present problems (1)-(3).

1 AN UNSCIENTIFIC ASSUMPTION

In all of the published Computer Graphics literature I've reviewed, "gender" is often used as a variable and, when it is, it is treated as a binary proxy for a set of physical characteristics. The assumptions behind its use as a relevant variable can and should be scientifically assessed.

The implicit, be it concious or unconcious, assumption in the literature seems to be that, physically, every human's appearance or behavior can be modeled as belonging to a very high-dimensional vector space $\mathcal{V}$ that could theoretically be spanned by a very large set of (not orthogonal) basis vectors $\{v_1, \ldots, v_n\}$ spanning subspaces like weight, skin tone, eye color, hair style, clothes worn, facial expression, etc. Furthermore, the assumption says, the distribution of humans in $\mathcal{V}$ follows a bimodal law, and one of the modes can be arbitrarily called female or woman while the other may be called male or man.

The above assumption is wrong, both in theory and in practice. Some of these attributes, like height, broadness of shoulders, voice pitch or hair length, may be empirically shown to *independently* follow what is well approximated by a bimodal distribution. What *doesn't* follow theoretically from this fact is that their *joint probability* also follows a bimodal distribution: in general, the joint probability of k bimodal distributions can only be said to be at most 2^k-modal. This undeniably manifests in practice too: [example??]. Similar arguments can be made with chest size, hip width, body-mass index, facial hair, hair style, voice pitch, etc.

2 A NON RIGUROUSLY DEFINED VARIABLE

The wrong bimodality assumption exposed above makes it so that researchers usually make arbitrary decisions on what "male" and "female" mean. While the specific definition used is not found on any paper I have surveyed, it is probably safe to assume that researchers usually use these binary categories to represent the modes of whichever physical attribute they subjectively consider most important for their application.

In some cases, these attributes may be trivial to identify. For example, [cite the thing] appears to use gender as a proxy for the shape of a person's torso to aid with sensor placement. In other cases, like where gender is an input variable to a neural network which learned on annotated data, the authors themselves may not know exactly which human characteristics are being mapped to this binary classification.

In most cases, the use of gender without a proper definition creates a model ambiguity which is detrimental to the advancement of science. For example, a voice recognition paper may refer to humans with higher pitched voices as female and humans with lower pitched voices as male, or it may be may be discriminating between certain speech patterns and word choices. Similarly, a full-body motion capture algorithm may use gender as a proxy for certain unspecified physiological attributes that aid with sensor positioning, for different ranges of Body Mass Index or for which poses and gestures are traditionally adscribed to a gender in a certain culture. Finally, a facial reconstruction algorithm may claim to take a person's gender as input, without clarifying whether it refers to the presence of facial hair or makeup, a larger or smaller jaw, or a person's facial expression.

3 THE REAL-WORLD IMPACT

As computer graphics researchers, we must be aware of the effect that our arbitrary modelling decisions have in the real world. Our algorithms are commercialized and used by governments, police departments, airlines and many more private companies with which the public is increasingly forced to interact in today's world.

A researcher's wrong assumption that a person's physiological characteristics are bimodal instead of multimodal lead to TSA body-scanners that routinely subject gender non-conforming people to ridicule and discrimination. A researcher's ambiguity regarding the gender output of a recognition algorithm makes it so gender non-conforming individuals can be often flagged for fraud if their recognized gender does not match their government identification. A medical imaging tool's use of gender with an unclear definition leads to transgender individuals going undiagnosed with severe illnesses. Current trends in the current use of gender as a variable in Computer Graphics research directly contribute to further harm communities which are already at higher risks of being mistreated by authorities and denied jobs or healthcare.

Furthermore, graphics researcher must consider our role in shaping the whose stories get to be told and who gets to seem themself be represented in the entertainment culture. In one fell swoop, by assuming a wrong bimodality in gender and making character models and animation rigs that use gender as a binary variable, we exclude gender non-conforming individuals from every videogame and movie created using our tool. By not examining our decisions around the use of gender in our algorithms, we contribute to further invisibilize already-invisible and marginalized communities, and in doing so contribute also to their ongoing opression.

Finally, the current use of gender in the Computer Graphics literature creates a hostile environment for gender non-conforming members of our research community, which goes against [cite some

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siggraph inclusion goal]: by seeing colleagues and collaborators consistently exclude us from their own research work, we are reminded that we do not belong in this research community, encouraging us to look for jobs elsewhere.

4 SOLUTIONS

There are generally four cases in which gender shows up as a variable in a Computer Graphics research work, and our proposed best practices vary for each:

(1) As a proxy for a mode in the distribution of a single human characteristic; for example, to describe hair styles. In this case, we recommend the gender reference be substituted, in the interest of disambiguation, for the actual characteristic: for example, instead of "male and female hairstyles", say "longer and shorter hairstyles".
(2) As a proxy for many simultaneous modes in the distribution of human characteristics; for example, animation of "male bodies" or "female bodies". In this case, the researchers should examine the necessity of this variable, and should be aware of the diversity of modes of human existence they are excluding by making that design choice, as well as their potential societal implications. Furthermore, if an algorithm only accepts as input or output gender conforming types, this should be stated as a major scientifical limitation of their work.
(3) As the central object of study; for example, works that purport to "detect" gender or "change" a given model's gender as their main contribution. The potential harms of this literature are so vast that we recommend authors to contact all the societal stakeholders, including trans and gender non-conforming scientists and ethicists, on the appropriateness and relevance of the proposed work.
(4) As aggregate demographic data on the participants on user studies, to guard against *reference man*-type research outcomes. In the vast majority of cases, this should be self-reported by user participants and not assumed by the person conducting the study.

5 OPEN QUESTIONS

To-do

REFERENCES

Amanda Phillips. 2020. *Gamer Trouble.* New York University Press.