Making Up 3D Bodies: Artistic and Serendipitous Modeling of Digital Human Figures

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Kiona Hagen Niehaus, Independent Researcher, Mainzer Straße 45, 12053 Berlin, Germany, k.hagen.niehaus@gmail.com

Rebecca Fiebrink, Reader, Creative Computing Institute, University of the Arts London, 45-65 Peckham Rd, London SE5 8UF, United Kingdom, r.fiebrink@arts.ac.uk

Abstract

This paper describes the process of developing a software tool for digital artistic exploration of 3D human figures. Previously available software for modeling mesh-based 3D human figures restricts user output based on normative assumptions about the form that a body might take, particularly in terms of gender, race, and disability status, which are reinforced by ubiquitous use of range-limited sliders mapped to singular high-level design parameters. CreatorCustom, the software prototype created during this research, is designed to foreground an exploratory approach to modeling 3D human bodies, treating the digital body as a sculptural landscape rather than a pre-supposed form for rote technical representation. Building on prior research into serendipity in Human-Computer Interaction and 3D modeling systems for users at various levels of proficiency, among other areas, this research comprises two qualitative studies and investigation of the impact on the first author's artistic practice. Study 1 uses interviews and practice sessions to explore the practices of six queer artists working with the body and the language, materials, and actions they use in their practice; these then informed the design of the software tool. Study 2 investigates the usability, creativity support, and bodily implications of the software when used by thirteen artists in a workshop. These studies reveal the importance of exploration and unexpectedness in artistic practice, and a desire for experimental digital approaches to the human form.

<1> Introduction

In context of their use in artistic and creative work, 3D human figures can be considered art objects, characters, and/or sites of digital embodiment, sometimes in overlapping capacities. However, little research has been conducted into digital 3D modeling, or the modeling of 3D human figures, which treats that modeling as a specifically artistic task, focusing instead on technical representation of existing physical or pre-designed objects. This approach to modeling human figures for use in a digital art setting limits the forms the artist is able to create, emphasizing the normative "wholeness" [1] (p.210) of an anatomically idealized body at odds with many lived experiences and a range of historical and contemporary artistic representation. From the hybrid figures of Hieronymus Bosch [2] to the reimagined biological structures of Stelarc [3], the intentional racial and gender stereotypes of Kara Walker's paper silhouettes [4] to the monstrous digital femininity of Linda Dement [5], abstraction, exaggeration and augmentation of human forms factors strongly in visual art. This paper describes the background, research, and process of designing a software tool for modeling 3D human figures which emphasizes creative exploration, unexpected results, and the body as a sculptural form.

<2> Background

Despite the relative ubiquity of digital 3D objects and characters in contemporary media, specifically in video games, animation, visual art, and film, digital 3D modeling remains a complex task with a high learning curve for untrained users. The availability of free, open source 3D modeling software options,

video tutorials adjusted for various skill levels, and libraries of template objects for general use may provide novice users with more options than have existed previously. However, modeling unique, highly detailed human characters that are rigged for animation and use in other domains still remains a difficult task for all but the most skilled specialist users. A variety of software packages have been released to enable creative users to model a wide range of 3D human figures with detail and precision, from paid software like the Poser series [6] to open source projects like MakeHuman [7].

While providing the user with a range of customizable options, these software tools also tend to limit the form a body might take by:

- restricting the characteristics and poses which may be applied to a figure based on the selected binary gender of the figure (mandatory across all studied software tools),
- using interaction design elements like range-limited sliders to define parameters for manipulating a particular area of the body (as in MakeHuman and DAZ 3D [8], among others), and
- using gendered and racialized language and labeling of user input (for example, labeling parameters differently based on the selected gender of the figure, as in Poser 11, or presenting racial characteristics as three sliders with values relative to one another, as MakeHuman does, pictured in Figure 1).

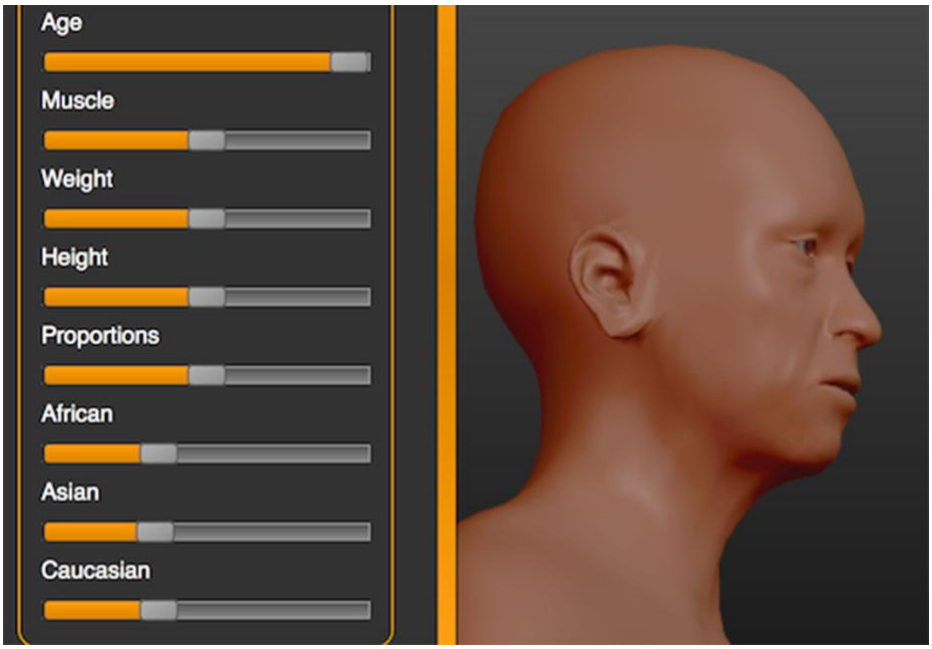

Figure 1. The MakeHuman software tool's macro and racial parameters.

While these limitations may simplify the design process for inexperienced users, they also preclude artists from using such systems to create figures with non-standard physical proportions and characteristics, reproducing normative discursive frameworks [9] which understand a body as 'human' based on having characteristics of cisgender maleness, whiteness, thinness, and able-bodied-ness by default. Defining a physical form for default 'humanness' means constantly reinforcing those norms, with such restrictions, "...crafted through the exclusion of other possible bodies" [9] (p.21). Rocha and Snetling have documented this normativity in MakeHuman in their inventory project, *Possible Bodies* [10]; software hacks—like reMakeHuman [11], which uses an ambiguously labeled version of MakeHuman's sliders to modify a 3D human form—are also documented there. Artworks by kyt [12], who subverts the

undifferentiated stock figure through uncanny positioning and animations, and Gabriel Massan [13], who investigates expression of gender, race, and identity by digitally sculpting colorful, highly textured 3D humanoid 'drag' avatars, provide current examples of 3D human artwork outside of a photorealistic paradigm.

Previous academic research exploring systems for facilitating easy 3D modeling primarily rely on range-limited sliders [14] or catalogue systems of segmented parts [15] to create usable tools for a wide range of non-expert users creating recognizable objects, creatures, and human figure models. Creative digital 3D modeling techniques, including scanning artwork [16] and human bodies [17] in order to create digital 3D models, creating digital 3D models from images [18], and digital sculpting tools which approximate the experience of sculpting with clay digitally [19] and in virtual reality [20] have also been explored. Software tools like *Alchemy* [21] and *Juxtapoze* [22] have been created to highlight the advantages of serendipity, suggestion and exploration in digital 2D creative practice. Motivated by critiques of bodily normativity and its social consequences, this project addressed a gap in this existing work by creating a flexible, non-restrictive prototype software tool for artistic, expressive, and exploratory modeling of 3D human figures.

<3> Artist Interviews: Study 1

The complexity of designing creative interaction for digital 3D modeling on a personal computer, which requires the user to manipulate a three-dimensional digital object on a two-dimensional, screen-based surface, complicates usability directives which stress the importance of connecting physical actions and affordances users already know to those used in software [23]. In order to explore how a prototyped software tool for modeling 3D digital human bodies could more clearly incorporate techniques from creative practice from a variety of media and look beyond the confines of a primarily slider-based interaction model, we interviewed six visual artists working with the body in clay, rope, linocut, drawing, and body-based physical performance art.

While selecting artists who work primarily in digital 3D modeling might have provided data on the perspectives and practices of existing digital practitioners in this domain, this would also have limited the artistic perspectives explored during the study to those who are able to work within the constraints of currently available software. All participant artists are LGBTQ; three are artists of color; two are non-binary and four are women. Each interview lasted between 20 and 45 minutes, and involved a series of questions about the artist's process, interaction with materials, and the language they use to describe their actions, followed by a short material manipulation exercise where the artist described their actions back to the researcher in real time. The interviews were audio and video recorded, and interview transcripts were coded and analyzed using a grounded theory approach, with sequential initial and focused coding phases.

During the interviews, the artists described engaging in clear decision-making patterns with regard to the materials they choose to work with, in terms of physical and tactile qualities, portability, cost, the relative labor-intensiveness of associated processes, and the degree of flexibility and tolerance for mistakes that is possible when working with a particular material. The artists' ability to access particular tools or processes and their own skill level and technical comfort with a process also influenced their choices in this respect. Each artist described engaging in a period of exploration, often near the beginning of a project or piece, and clearly articulated the role of incorporating mistakes, surprises and unexpected results in shaping the artwork they create. Additionally, the simultaneous spatial and internal awareness described by artists who work with their own bodies as materials raises questions about the default, third-person camera perspective of tools for modeling 3D human figures, when such figures may also be used to facilitate digital embodied experiences.

<4> CreatorCustom Prototype

Building upon existing research and the artist interview data, we designed a prototype which addresses the limitations of existing software tools while allowing for novel modeling directions to emerge. Rather than limiting the form of the body to that which is anatomically or physically possible, the CreatorCustom prototype tool facilitates sculptural exploration of digital human forms. This emphasis highlights material characteristics and advantages of mesh-based 3D modeling, where parts of the body can be expanded, reshaped, or inverted by moving the appropriate vertices, rather than painstakingly sculpted by hand, as in clay or other physical materials (Figure 2).

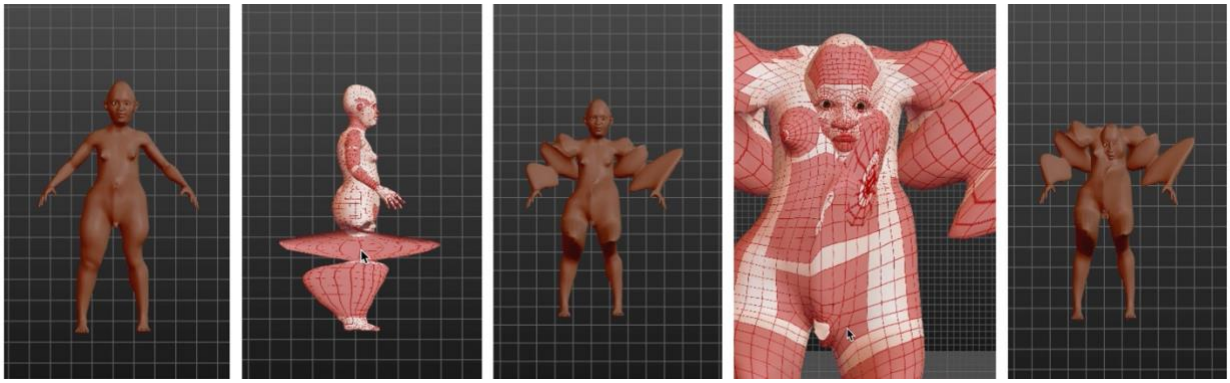

Figure 2. Chronological snapshots of the process of modeling a figure in CreatorCustom (left to right). (© Kiona Hagen Niehaus. Photo: Kiona Hagen Niehaus.)

Building on MakeHuman's open source repository, CreatorCustom repurposes the slider-controlled manipulation parameters and morph targets for direct manipulation interaction, where the artist drags, pulls, and otherwise manipulates active areas of the figure mesh directly and without limited end-points (Figure 3). This approach to interaction forms a middle ground between beginner-level 3D modeling tools, which use sliders and other GUI elements to manipulate the figure mesh indirectly, and general 3D modeling tools, which allow the direct manipulation of individual vertices. Additionally, the mesh morph targets themselves were reshaped and expanded in order to encompass a greater potential diversity of bodily characteristics. The area affected by the artist's manipulation is split into three escalating levels of detail, and artists can manipulate the figure body using five distinct tools. These tools, based on similarities between the in-program results and physical artist actions and their visual results as described by participants in the artist interviews, are Push/Pull, Squeeze/Loosen, Carve/Round, Add/Collect, and Move.

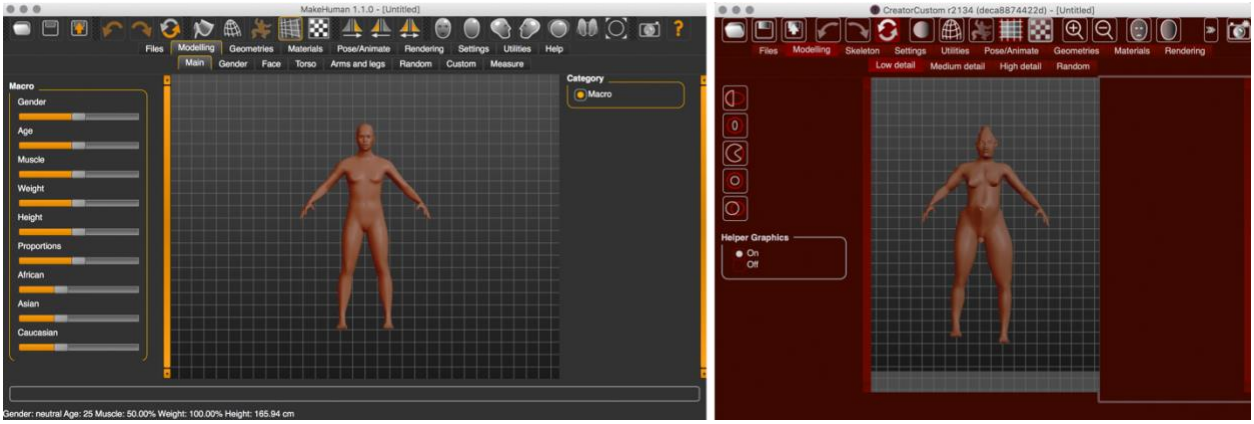

Figure 3. Comparison of MakeHuman software (left) and CreatorCustom software prototype (right).

The importance of surprise and unexpected results as described by the interview participants, particularly in the exploratory stage of practice, was incorporated into the design of the starting point of CreatorCustom, which is randomized across all parameters in CreatorCustom. Rather than defaulting to the same 'neutral' figure, the starting point of the prototype tends toward particular characteristics associated with size, gender, race, and disability which other systems for modeling 3D human figures exclude (Figure 4). While the figure's material color is also randomized within a broadly skin-colored range, the software prototype gives the user a wider range of choices through providing a color picker for custom material creation. Finally, the 3D camera views available within the software tool include a 'point-of-view' camera, which represents the figure's body when viewed from its own visual perspective, to allow modeling from an embodied viewpoint.

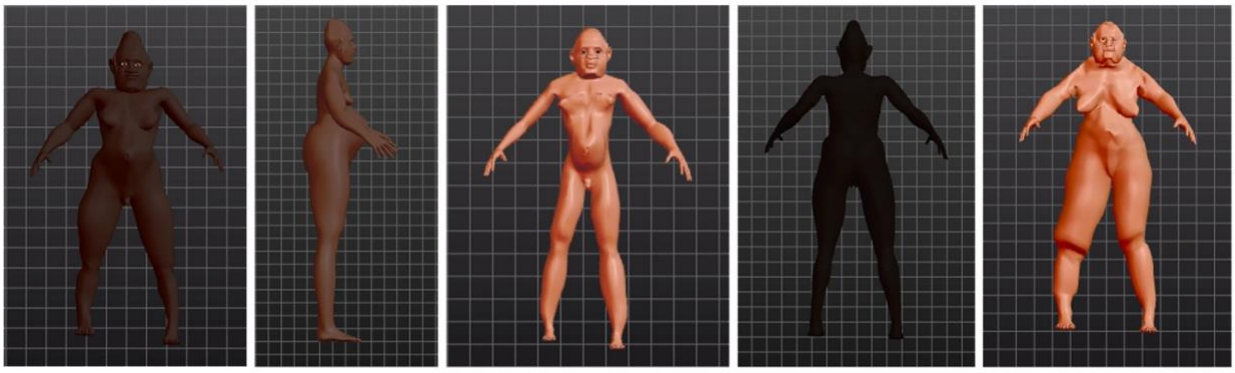

Figure 4. Examples of the randomizer results in CreatorCustom. (© Kiona Hagen Niehaus. Photo: Kiona Hagen Niehaus.)

<5> Workshops: Study 2

Relatively little scholarly research has focused on tools for modeling 3D human figures, especially with regard to user experience and interaction. The affordances of these tools, particularly in terms of the bodies they are able to produce, have likewise not been scrutinized publicly with emphasis on usability, creativity, or the user's experience of what they are able to create using the tool in practice. As such, the purpose of this study was to evaluate the usability of the tool, and to gain further perspective from artists on its affordances, the experience of use, and the figure bodies the tool produces. The goal of these workshops was not literal or figurative self-representation by the participants. Participant artists were recruited from a variety of visual art backgrounds and all created artwork which centers the body visually or conceptually. In total, 13 participant artists were recruited through an intake survey disseminated through social media and email. The participants were seven women, three men, two non-binary people, and one genderqueer person, nine reported some form of LGBTQ identity, and five participants were of color, while the rest were white. Participants had varying levels of experience with digital 3D modeling software and tools for modeling 3D human figures; these perspectives may provide clues to fruitful research directions in the future.

Each workshop lasted 3.5 to 4 hours in total with 2–4 participants; participants were shown briefly how to use the software tool, then given time to brainstorm their ideas on paper, and to work with CreatorCustom for 40 minutes, first in pairs and then alone. After the second session of working with the prototype, participants participated in a group interview, and were given the opportunity to add feedback later through an online form. Participants were paid 40 GBP for their participation. The sessions were audio, video, and screen recorded, and interview transcripts were coded and analyzed according to a grounded theory approach, with initial and focused coding phases.

Many participants found the direct manipulation interaction difficult to understand, and several participants experienced the tool as providing more unexpected or serendipitous results than they found pleasurable. Several participants expressed frustration with the lack of technical specificity with which they were able to interact with the software, a specificity which they appeared to expect of a digital 3D modeling tool. However, during the interviews, the participants with extensive 3D modeling experience highlighted the flexibility and opportunities for exploration offered by the software prototype. One participant, who has significant experience with both general 3D modeling tools and uses 3D human figures in their work, described becoming immersed in the tool, saying, "You're inside and processing, making, not inside the process of learning, debugging, checking." They likened the environment of general 3D modeling tools to that of having too many different drawing supplies, where the choice of which pen to use hinders the artist's exploration of their underlying concept, which they felt to be in contrast with the simplicity of CreatorCustom's five tool functions and limited interface. While some participants expressed discomfort with the forms of the figure bodies, others reported a feeling of commonality or conceptual interest in the forms they created (Figure 5). Another participant stated, "I feel like that's a big part of being trans. It's like, well, it's very random, actually. Like how the body changes with hormones …I felt quite represented in that."

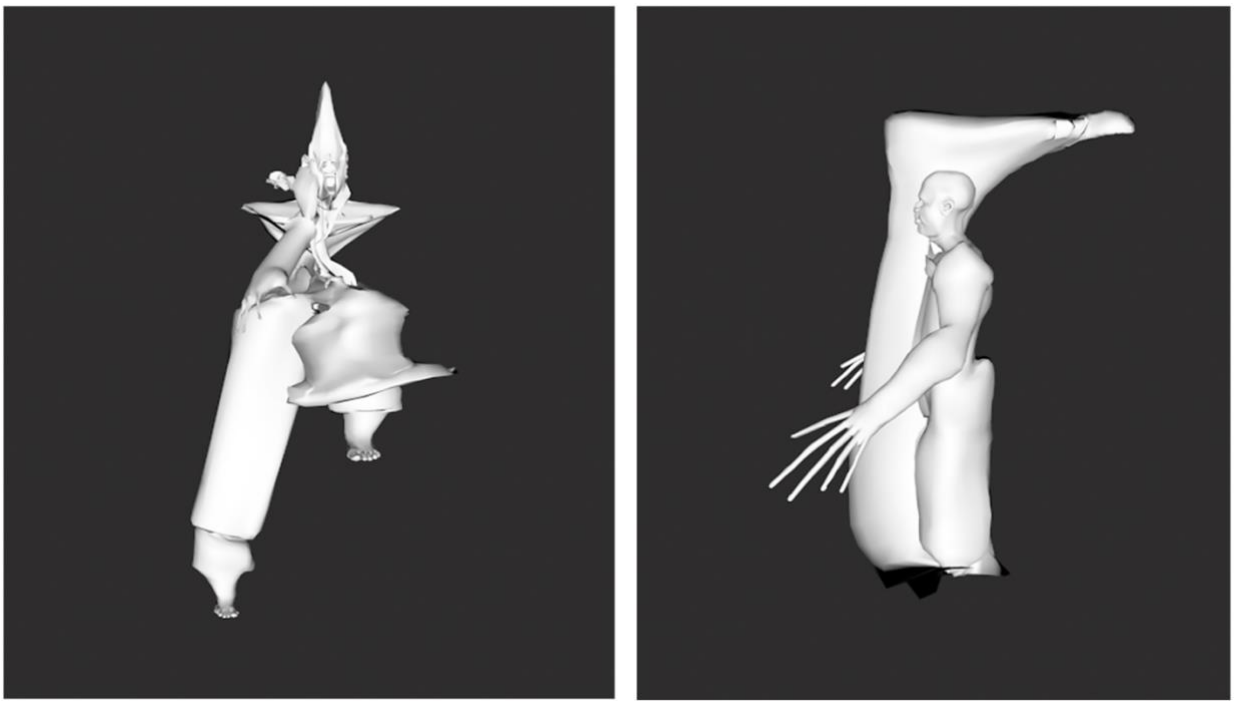

Figure 5. Two figures produced by LGBTQ participants using CreatorCustom. (© Pete Jiadong Qiang (left), Mylo Dylan (right). Photo: Kiona Hagen Niehaus.)

<6> Personal Account

Niehaus is also a visual and interactive artist, and uses 3D mesh-based human figures in her artwork. As part of this research, she used CreatorCustom in her own art practice and kept a written diary after each session of using the software prototype to create artwork, over a period of four months. This process provided documentation of her experience of the tool from an artistic perspective, and offers some insight into how the tool might affect creative practice over time. The written diary was coded according to a grounded theory approach, with initial and focused coding phases.

In these diary entries, it is clear that the serendipitous qualities of the tool influenced the figures that Niehaus produced. She repeatedly described forming a body part into a shape she had not anticipated but found pleasing, and basing her figure design around that body part or feature thereafter. She articulated a feeling of relief in finding an experience she deemed similar to 'sketching' in a digital tool, stating, "I'm not focused on the wording or even the parameters so much; I feel more like I'm moving and feeling my way through working with the body, rather than focusing on what the particular parameters are." Although Niehaus was attuned to a variety of norms surrounding the body and its representation through conducting this research, she described the tool as "bringing about a lot of change" in how she visually represents and explores the body in her artwork, since CreatorCustom prevents the user from creating a normatively proportioned body. These differences are evident in the contrast between figures produced by existing software tools, and the figures she created using CreatorCustom, pictured in Figure 6.

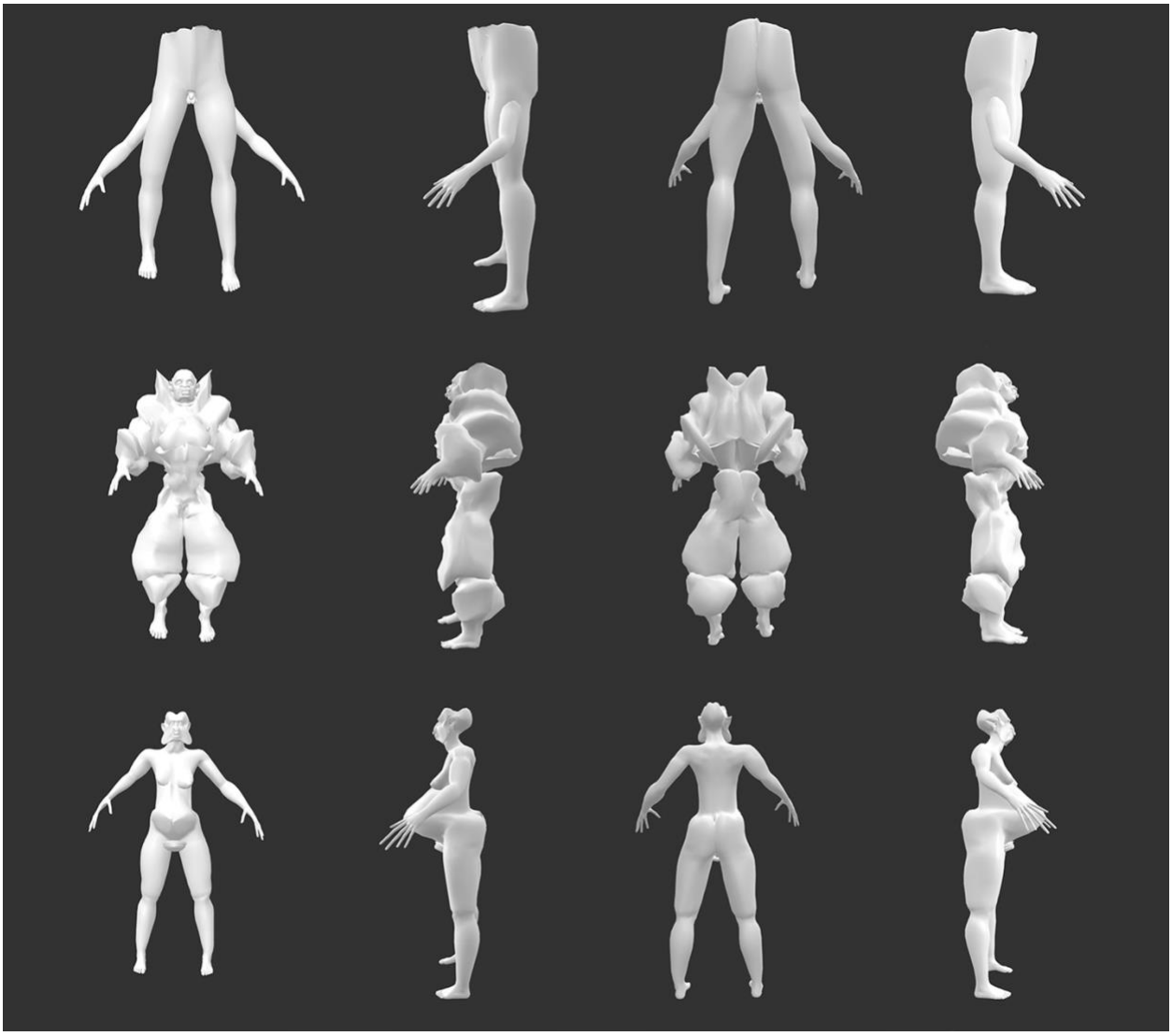

Figure 6. Three figures produced using CreatorCustom, viewed from the front, left, back, and right sides, from left to right. (© Kiona Hagen Niehaus. Photo: Kiona Hagen Niehaus.)

<7> Conclusion

CreatorCustom is a software prototype which aims to facilitate artistic and serendipitous exploration of 3D digital human forms. The prototype's emphasis on exploration and unexpected results, rather than technical precision, provides an example of an alternative framework for evaluating the purpose, usability, and role of software in facilitating the creation of artwork. While accurate representations of existing objects are important in some artists' work and practice, other artists may prefer to explore such representation in expressive or symbolic terms. In the case of representing human bodies in particular, there are social as well as creative consequences to prescribing human forms and characteristics, and the software available to artists restricts the artwork they are able to create. Centering abstraction in tools for representing the digital body opens up new possibilities in the domain of 3D modeling software as an artistic tool.

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Bibliographical information:

Kiona Hagen Niehaus is an independent researcher, UX designer, and artist interested in bodies, embodiment, and relating. She holds a PhD in Arts and Computational Technology from Goldsmiths, University of London.

Rebecca Fiebrink is a Reader at the Creative Computing Institute at University of the Arts London. Her research enables new forms of human expression, creativity, and embodied interaction in music, gaming, and accessibility technology.