We present Wo.Defy, a bio-responsive wearable garment that reflects wearer’s breathing and rhythm as a series of metaphorical patterns within the interface. Our design advocates for shifting the attention of the wearer to induce inner emotional change through reflection. Our concept was constructed based on an extensive process of historical-cultural research, material exploration, and iterative design based on a Chinese suffragette group in the late 18th to early 19th century of China known as the Self-Combing Sisters. Through the act of wearing the dress, Wo.Defy reveals the inner rhythm of the wearer: we support an awareness of the self’s emotional state that acts as a gateway for the Self-Combing Sisters’ choices from the past to advocate for self-agency in relationship to their choice around marriage.

**Author Keywords**
Self-Combing Sister; Historical Cultural Research; Wearable Interface; Breath Interaction;

**ACM Classification Keywords**
H.5.2 [User Interfaces]
Introduction
Bio-medical studies and discussions in somaesthetics reveal that practiced attention, reflection, and articulation of one’s emotional and physical body state support self-knowledge and can lead to higher-levels of physical, cognitive, and emotional performance in our daily lives [1,7]. Existing bio-sensing wearable application designers have acknowledged the benefits of communicating the wearer’s bio-data for purposes of self-regulating and conditioning for the body [4,5]. Research in these bio-sensing wearable products have indicated the current need to design compelling personal user experiences that elicit meaningful connections between the user and their bio-data. We want to investigate how integrating cultural historical research within wearable aesthetic design process can foster detection, expression, and regulation of the wearer’s physiological well-being and performance. Specifically we articulate this through increasing the wearers’ attentional skills to their breathing.

Design Reflection and Inspiration
Culturally oriented HCI research predominantly focuses on representing the larger cultural expression external to our body yet their remains far less focus on expressing the internal voice of self within cultural expression [4]. We explored the use of historical-cultural narratives in Wo.Defy to convey the intimate self-commentaries of the Self-Combing Sisters’ resistive practices and rituals surrounding traditional Chinese conventions of domestication.

Wo.Defy’s design is informed by historical precedent - a suffragette group known as Self-Combing Sisters, Zì shū nú (自梳女), which existed during the late 1800s to mid-1900s in Guangdong, China [6,8]. The Self-Combing Sisters challenged the social norms for Chinese women by choosing celibacy over arranged marriages. Many became breadwinners, and held employment within silk weaving factories [8]. This raised their socioeconomic status within society and redefined them as independent and self-sufficient women. The cultural significance to “self-comb one’s hair (自梳)” is to self-initiate a social practice that produced a distinctive, self-effacing aesthetic appearance: a bounded bun or plait of a married woman. This bounded hair referenced their decision to conceal the female semblance of youth, beauty, sensuality, and seduction [6,9]. The critical reflections and self-actuation by the Self-Combing Sisters articulate a foundation for the conceptualization and development of the Wo.Defy dress.

Design Process and Development
Wo.Defy’s design process incorporates the attitudes of the Self-Combing Sisters as inspiration for the selection and development in its poetic design within the form and interaction.

Guided by insights from interviews, self-reporting walkthrough scenarios, video documentaries, photographs, we identified silk textiles, hair braid/bun, and the Chinese qipáo dress (旗袍), as three elements that are culturally associated with the Self-Combing Sisters. We investigated their physical compositions, movement qualities, and characteristics to determine how these three materials may be combined and integrated with bio-sensors. By incorporating material exploration within the DIY practice of wearable technology, Wo.Defy goes through four phases of iterative design involving three prototypes:

Figure 2. Front and Back Designs.

Figure 3. The network of floral-like organza forms throughout the front and back of the dress.

Figure 4. The shoulder shells cover the 2 servomotors that drive the contractions of the floral forms.
1) A paper block pattern with adjusted pivots and seam lines to determine the circuitry design, soft textiles and hardware materials required for construction. (2) A Paper-based qípáo was derived from the paper block pattern to refine the fit and circuitry mappings on a 3D body. (3) A Silk based prototype focused on the integration of the hardware with soft forms. (4) The current dress form focused on the refinement, calibration, and troubleshoots for the sensors, servos, and circuitry design.

**Current Dress Design**

By integrating the cultural narratives of the Self-Combing Sister, we challenge the conventions of Chinese traditions through the aesthetic design choices.

**Form**

Structural elements of the Chinese wedding dress, qúngguà (囍褂), are integrated in the reconstructed qípáo form as reference towards the women’s “marriage to herself” [6] as resistance to arranged marriages. Combining a Chinese-West, cultural juxtaposition in the use of white, the dress signifies the death of the oppressed self for a renewed life towards self-actuation and agency. The dress features re-appropriated shoulders and neckline that align with male clothing to reference the shouldering of responsibilities as a breadwinner. The adjustments were made to signify the lived experience of the Self-Combing sisters who took on economic and social responsibilities like a male breadwinner.

**Materials: Reflections through Silks and Hair**

The soft materials of dupioni silk, raw silk fibres and human hair constructed a system of cultural metaphors to advocate the lived experiences of the Self-Combing Sisters. Multiple forms of raw silk are hand-sewn and crocheted, conveying the versatility of the Self-Combing Sisters, highlighting their silk-weaving craftsmanship, and recognizing their constructive economic contributions to their community. Human hair acts as memory capsules and within its physical structure, directly reflects the health and vitality of the body at a specific time [6]. The braid of black human hair transitions from the collar into a network of white raw silk fibers and organza floral forms on the torso to portray the generation and degeneration of the Self-Combing Sisters’ narratives towards life, beauty, and self-disclosure towards agency.

**Interaction Semantics for the Corporeal Breath**

Wo.Defy displays the corporeal breath of the wearer through translating the wearer’s breathing patterns into visual and kinetic expressions. The displayed expressions enable the wearers to take notice in the shifts from behavioural (autonomous) breathing to sensory breathing [3]; to become aware of one’s own breathing to understand how the body reacts based on how one feels. A pair of bio-sensor is used to collect the movement and pressure data from the expansion and contraction of the diaphragm. (1) The Arduino Lilypad manipulates light pulsation according to the pressured data captured from the squared piezo force sensor, which is located on a silk chest band found underneath the dress. (2) The Arduino Uno controls a pair of 360 degree servo motors based on the XYZ movements as captured by the tri-axis accelerometer on the vertebrae. The servo motors pull a network of threaded organza flowers based on the amplitude of the wearer’s breath. The illumination of LEDs and contractions of the floral-like organza forms reference the diaphragm and pubococygeus muscles in an...
intimate body state upon emotional arousal. Exhibiting this intimate reaction of the female body invites a discourse on the choice to withhold or reveal one’s body state, which enacts metaphors towards self-control and self-agency from the Self-Combing Sisters.

**Initial Inquiry through Breath Interaction**

During seven exhibition showcases, we conducted short interviews, talk-aloud self-reporting, and direct observations on participants’ direct interactions with their own breath pattern through the dress’ chest band. In sum, our initial findings indicate: (1) Incorporating a historical cultural narrative provides a legible context for shaping the user’s awareness of their own body state within a cultural context (2) Embedding biosensors within raw and natural textiles enables unobtrusive collection of body data. (3) Capture, revealing, and amplifying the inner breath and kinetic rhythm can direct attention towards self-presence for self-reflection.

By revealing subtle breathing rhythms and muscle movements, Wo.Defy situates as a critical design wearable that raises awareness, generate reflection, and inspire transformation of wearer’s self-state by magnifying the bodily expression of her self-presence.

**Conclusions**

Wo.Defy employs wearer’s breath rhythms to unfold the wearer’s emotional responses to their outer surroundings. As a carefully constructed cultural representation, Wo.Defy delivers a lived experience for the wearer, inviting an experiential understanding of the historical narrative of the Self-Combing Sisters by weaving historical values and practices within real-time interaction invoked by the wearer’s breath. Through an initial qualitative inquiry the dress was successful in fostering the wearer’s immediate shift of attention and consideration towards self-state to elicit self-reflection. Wo.Defy generated meaningful reflection and discussion about the wearer’s inner attitudes and reflections, while simultaneously opening discourse around agency and representation of the display of intimate body data.

**References**


