Bodies that Measure and are Measured

in the context of perinatal care

Paulina Yurman
University of the Arts London
p.yurman@csm.arts.ac.uk

ABSTRACT

Perinatal care roughly consists of the period between the start of a pregnancy and up to a year after birth, although some health practitioners use the term to loosely include up to 2 years postpartum. A range of technologies are used for reading signs related to health and wellbeing during this period, from foetal heart monitors to devices for tracking infants' breathing patterns, temperature, movement or sleep. Alongside these technologies, parents, midwives, health visitors and caregivers develop practices for measuring wellbeing that are non-numerical, sensorial and often culturally dependent. Although often not recognised as sufficiently scientific, these practices are nevertheless informally used in assessing wellbeing and are interwoven with knowledge emerging from monitoring technologies. This pictorial presents insights, reflections and examples of tools and metaphors used in such assemblages of practices, gathered through conversations and workshops with stakeholders, together with selected early design explorations addressing aspects of this topic.

Keywords: bodily knowledge; technologies; soma design; perinatal; non-numerical

CSS Concepts • Human-centered computing~Interaction Design

C&C '26 July 13--16, 2026,London, United Kingdom

ACM ISBN 979-8-4007-2583-8/2026/07
https://doi.org/10.1145/3803784.3809270

'I rely on my bodily senses, even when I read the foetal monitor' *(conversation with midwife)*

'When the placenta is being expelled during labour, the uterus contracts and feels hard, like a cricket ball' *(conversation with obstetrician)*

Figure 1: 'When the uterus contracts it feels 'hard, like a cricket ball'

Introduction

This pictorial paper presents visual and verbal examples of ways in which the body is measured and sensorially described during the perinatal period, and how the body itself is used for measuring other bodies and environments, practices that are intertwined with machine focused monitoring technologies. The examples presented here were gathered in this research through a mixture of activities: conversations with practitioners and researchers working in maternal health in the UK, design-led workshops addressing experiences with various types of designs and technologies for perinatal care, research into archives of designs and technologies, perinatal health literature and online sources. These activities form part of *Maternal Machines: Design Speculations about Fantasies of Care* [40], a research-through-design project investigating imaginaries, ideations and design opportunities in spaces related to maternal and infant care. The gathering of reflections, examples and anecdotes in practices of perinatal care is an ongoing activity in this research, as new insights are still emerging. This pictorial paper presents selected images that illustrate tools and methods used to describe, measure or learn about the body, together with verbally shared insights, metaphors, and descriptions. The images, quotes and text are meant to be viewed as diverse multimodal resources in which caregivers, health practitioners and parents communicate and measure the body and its wellbeing. Alongside these shared examples are early design explorations that respond to some of specific aspects and themes in the research.

Background of the topic

There are commercial apps in the market that use AI to 'translate' and analyse an infant's cry and suggest potential reasons for their crying, or to scan a dirty nappy to give a general indication of digestive wellbeing. Machine learning is also being used to research detection of postpartum depression in mothers through applications that rely on facial and voice recognition, in self-driving prams, biometric smart devices and

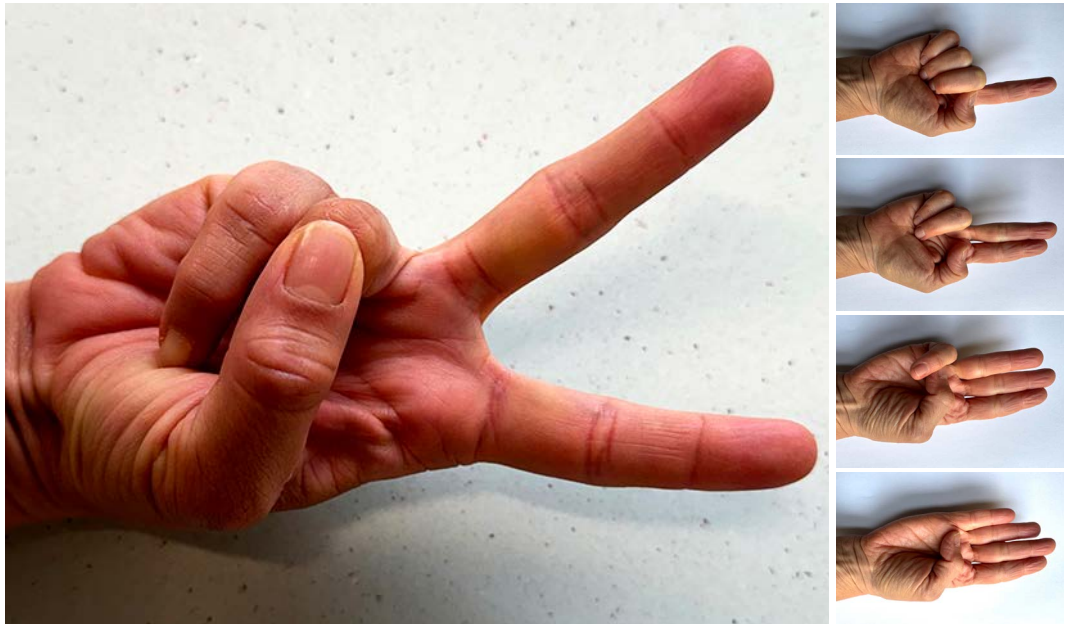

Figure 2: midwives often use their fingers to check cervical dilation during childbirth

applications. These examples form part of a long history of aspirations to use designed technologies in spaces related to reproduction, childbirth and care [9, 13, 14, 26, 33, 34]. They raise important questions about the authoritative role given to machines in situations that are often changeable, somatic and subjective and that are an entangled network of biological, psychosocial and cultural variables. In the realm of commercially available technologies for new parents, the promise of control, reliance and surveillance offered by monitoring technologies can be attractive during a period when most parents navigate uncertainty and unpredictable outcomes [13] and where the body - infant, pregnant, postpartum or lactating - is of leaky [31], expanding and contracting boundaries. Monitoring technologies for new parents can present a medicalised perspective of parenthood that many find reassuring, yet they can also undermine bodily and culturally situated forms for estimating wellbeing. The selling point of many such technological interventions is rooted on notions of machines as providing objective (and implicitly more reliable) knowledge, and at odds with human subjective and sensorial perceptions. This authority attributed to machines as supreme carers is not new. When early incubators were first presented to the public towards the end of the nineteenth century, some obstetricians argued that such machines could possibly be safer than mothers themselves, due to their *'over emotional, excessively stimulant, irresponsible,*

unstable or uncontrollable behaviours' [1, 3, 14]. Such judgements, affected by intersectional issues of gender, race and class that support ideas of reproduction and parenting as a scientific project, echo comparisons between machines and the maternal body that are rooted in historical understandings of the female body as a reproductive machine with a set of biological functions. Such essentialist conceptualisations, inherited from 18th century perceptions of the female body as a deviant of the male model, carry complex and problematic issues related to the politics of birth and reproduction [31, 43, 44, 45, 46].

Contemporary critics of the role of constant monitoring technologies during childbirth point to the disruption it creates in its authoritative overriding of the mother's own embodied knowledge [16], and in the dynamic relationships between the body, the foetus and the midwife [12, 23]. In its partiality towards a medical stance, the machine gives the impression of it being responsible for maintaining the baby alive, whilst also giving the foetus an identity separate from the body upon whose survival it depends [23].

In the technologisation of practices of care, certain tasks become translated into programmable actions that can result in the privileging of efficiency and predictability over relational attunement between bodies. To be clear, advances in neonatal medicine and technology have drastically reduced rates in maternal and infant mortality, and this pictorial paper does not advocate for a return to pre-modern medicine (although it should be noted that one reaction to the increasing medicalisation of childbirth is the rise of the freebirth movement or self-birth, advocating for birth without regulated healthcare professionals, which can pose significant risks to both mother and baby). It is important, however, to critically interrogate many of the narratives surrounding commercial monitoring and tracking technologies that present them as uniquely trustworthy and reliable forms of knowledge in care practices. It is also valuable to acknowledge that alongside readings from quantifying technologies during the perinatal period there exist diverse practices, often done privately, that are orally passed and culturally situated, and that rely on the body as a tool for assessing wellbeing. These sensorial estimations are

Figure 3: Alongside Doppler foetal ultrasound devices, the Pinard is still in use today to directly listen to the foetal heartbeat. Using the Pinard stethoscope is less common nowadays if there are machines to do this work, yet they are also deemed highly reliable by health professionals.

by no means neutral nor reliable on their own. For example, newborns are often diagnosed with jaundice if their skin has a yellow colouration and health practitioners often fail to diagnose it in babies with dark skin. The most accurate way to check for jaundice is through blood tests, usually carried out after an initial diagnosis made from visible symptoms. This is an example of how readings made with designed instruments and with the body's senses are interlinked in practices of care. The word perinatal is defined in the dictionary as the period comprising pregnancy and the first year postpartum, yet many health practitioners use it to broadly refer to up to two years after birth. This is also an indication of the flexible boundaries that exist to describe this

period. The medicalisation of pregnancy, childbirth and care and the different ideologies that advocate for more 'natural' approaches to care are contested lines of thought that can lead to binary understandings of either fully natural or techno-medicalised approaches. However, there exist notable initiatives to improve maternal and infant care and reduce mortality through the integration of modern obstetric knowledge with knowledge from local midwives who have a key role in communities and offer practical and spiritual support [39].

Gathering insights through conversations and participatory workshops

Conversations with practitioners and researchers working in perinatal health were carried out during the early stages of the research and a number of those individuals were later invited to take part in workshops alongside other stakeholders. Twelve workshops were organised, the number of participants ranged between two and twelve and consisted of: midwives and health visitors, parents and caregivers, researchers working in HCI and design, AI and ethics, in medical humanities and in maternal health. During the workshops, participants were invited to draw or visualise and discuss in group situations in perinatal care and experiences with artefacts and technologies (real and imagined) [33, 34, 41]. Participants could create their own drawings or use previously created drawings (of humans and of thermometers, scales, monitors, breast pumps, cots, bottles, prams, cameras, robots, Alexas, etc.). In some of the workshops magazine cutouts were also available. Discussions about the visualised scenarios facilitated the sharing of diverse perspectives and experiences. Participants who were researchers or practitioners and who were also parents or caregivers contributed with observations or insights that stemmed both from their perspectives as receivers and as providers of care. A question that emerged early in the research during individual conversations involved ways in which non-numerical or sensorial estimations might be used for assessing wellbeing or for describing the body. As the research progressed, this question became incorporated into

Figure 4: Workshop with practising health visitor students, many with previous experience as midwives and nurses.

conversations during workshops and participants shared examples used to measure or describe the body during the perinatal period. For example, a mother drew the facial expressions of her baby, with descriptions of how each shape of her mouth indicated hunger, tiredness or a dirty nappy (figure 5). The baby's grandmother, who also provided care for the baby, assigned different meanings to them, an example of how subjective the reading of facial expressions can be, even for the same face.

Other sources that provided illustrative examples were found in maternal and infant care journals, online sources of commercial and medical devices for perinatal care and in a visit to a teaching medical centre in a University in London, where designed props are used for demonstrations about pregnancy, childbirth and postpartum care. My experiences during my early years as a parent also provided some autoethnographical familiarity with the topic.

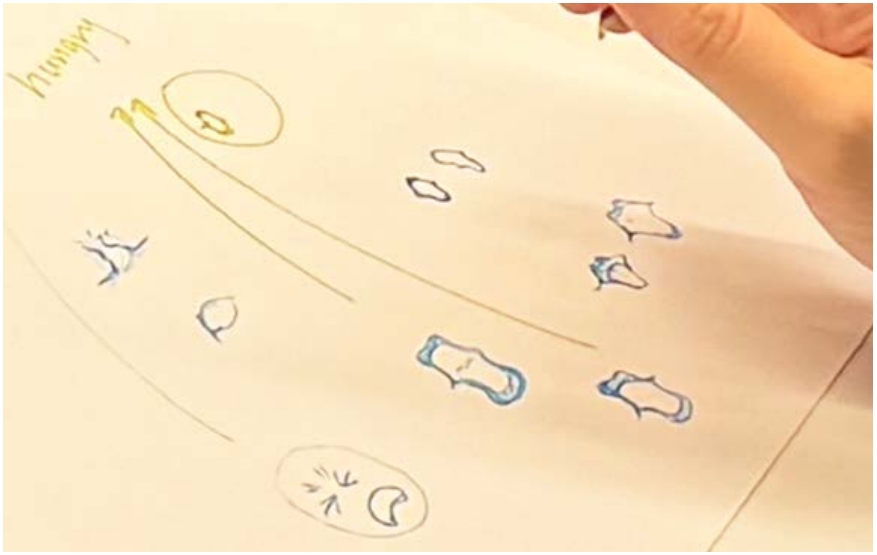

Figure 5. A mother's drawing of the facial expressions of her baby and the different shapes of the mouth when she cried, that she read to indicate hunger, tiredness or a dirty nappy. The baby's grandmother, who also provided care for the baby, assigned different meanings to them, an example of how subjective the reading of facial expressions can be, even for the same face.

The diverse nature of the collected examples, using visual or tactile images to describe bodies (*'my newborn niece is small; her length would roughly fit in an A3 sheet of paper'* or *'the cervix feels like the tip of your nose'*) point to multimodal ways used to describe specific aspects in perinatal care situations. In this pictorial, these are presented as illustrative accounts of care practices, which share some parallels with methods used by craftspeople in their creative work. This points to possible understandings of practices of care as forms of craft, and of the resourceful and creative approaches used by caregivers. The development of a sensitivity towards such ways of knowing in practices of perinatal care enabled me to notice aspects that might otherwise have been overlooked or dismissed as mundane [2, 25] and to identify them as worth noticing. This reflective approach in the research, inevitably also informed by my own experiences as parent, have informed and added context to the design activities and responses developed as early design explorations.

Tools, metaphors, crafts and senses to describe and measure the body

'The cervix feels like the tip of your nose'

'The baby's first poo is called meconium and is black and sticky, like tar'

'The newborn stomach is the size of a marble'

'The poo of a breastfed baby might be yellow, like mustard'

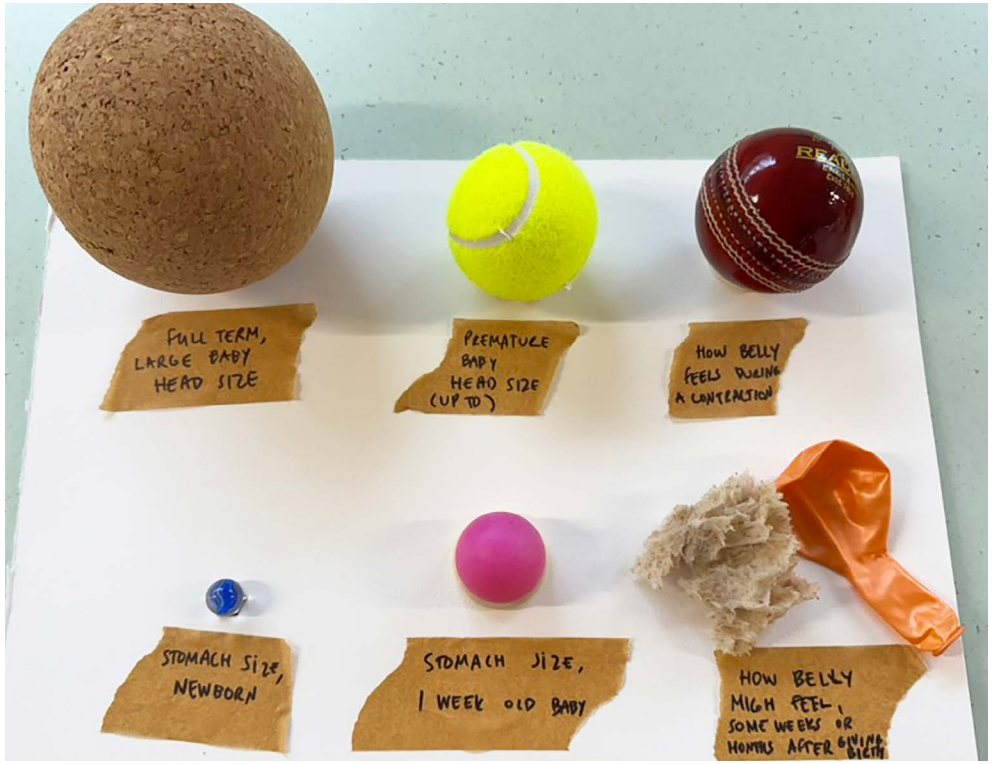

Figure 6: Material metaphors to describe the postpartum and infant body. These metaphors were mentioned during various conversations and workshops. For this pictorial, they have been materially put together. From left to right and top to bottom: a ball the size of the head of a large baby born full term, the size (up to) of the head of a premature baby, a cricket ball, hard like a uterus during a contraction in labour, a marble to indicate the size of the stomach of a newborn baby, a ping pong ball to indicate the size of the stomach of a 1 week old baby, some bread dough and a deflated balloon to indicate how the postpartum belly might feel.

'Some weeks after giving birth, my stomach felt like bread dough'

'When my baby was born, his head was the size and colour of a small pumpkin'

'My newborn niece is small; her length would roughly fit in an A3 sheet of paper'

The previous examples, together with visual and material metaphors, illustrate ways to describe the body during the perinatal period. It is worth mentioning that the body has long been used as a tool for measuring:

The rikra, an ancient Inca unit, is the distance between the fingertips of outstretched arms

The foot as a unit of length

A finger of water above the level of rice to indicate the amount of water needed for cooking it

A chef's method for checking how well cooked meat is, touching the different levels of hardness in the flesh of a fist as reference

In ancient Egypt, a cubit was the distance from the elbow to the fingertips

For his book *Expert* [20] surgeon Roger Kneebone interviewed various craftspeople and studied their interactions with the materials they work with. His conversation with ceramicist Duncan Hooson suggests forms of bodily understanding and sensitivities that require a dialogue with materials. Both Kneebone and Hooson describe their practice as requiring a form of attentiveness, of seeing with fingers and hands. This is also echoed in Sennet's description of material consciousness experienced by craftspeople, derived from a dialogue with the materials in use [30]. Kneebone also reported to experience a form of material consciousness in his practice as a surgeon, where the body and its organs are also *'materials tested on the verge of collapse'* [20, p.87].

Creative practitioners often use metaphors to convey certain knowledge to others, for example describing the right consistency and *'scale of squidginess'* [20] of clay needed for certain processes as similar to pouring cream, or the

Figure 7: Demonstration tools used by feeding consultant Caroline Reid

Figure 8: Crocheted 'boobs' made by paperloom5 (left) and other breastfeeding demonstration tools (right). Attitudes towards consent and touch of the postpartum body have changed over the last few decades. While once it was common practice to directly touch and position the breast and baby to ensure latching, current practitioners use props such as these to demonstrate.*

paste for some 3D printing technologies as similar to pasta dough. Parallels between craft practices and practices of care in the use of the body for measuring have also been noticeable in this research: ceramicists have told of ways in which touching clay with a cheek can indicate its readiness to be fired (if it feels cold it means it is too wet and not ready for the kiln). Midwives use their hands to check the length of cervical dilation during childbirth (figure 2) and learn to use their fingers to feel the position of the baby as it enters the birth canal (figure 11), using head dolls specifically designed for them to learn to 'see' with their fingers.

Alongside the use of foetal monitors, midwives rely on their sense of hearing using pinards (figure 3) that enable them to directly listen to the heart rate of the foetus. Sensorial practices coexist alongside readings created by machines, and health professionals rely on their senses constantly, by making assessments based on what they see, displaying high levels of integration with their sensorial knowledge in their clinical practice.

Some midwives, lactation consultants and health visitors create their own tools to show practices of care or to measure or describe aspects of the body, using visual charts, or crocheted and knitted objects (figures 7, 8 and 9). The creation of visual and tactile allegories to describe the body are also manifestations of forms of craft, of the craftmanship of care, which can involve making visual bodily props serve to pass on information that would otherwise be difficult to describe. Many of these created metaphors are culturally dependant. For example, the description shared by an obstetrician to portray the tense status of the uterus during childbirth when the placenta is being expelled as *'hard, like a cricket ball'* (figure 1) relies on being familiar with the ball used in cricket.

From a design perspective, metaphors used to describe or measure bodily aspects during the perinatal period can offer opportunities for exploring visual and material ways in which to communicate aspects of the body or somatic experiences, beyond quantifying technologies. They can illustrate the extent to which how we view bodies is culturally and bodily situated, since they refer to metaphors that might be familiar to some, but less so to others. They can potentially offer opportunities for designing visual tools to support and empower practitioners and receivers of care in descriptions of somatic

Figure 9: Knitted and crocheted tools are often used or even made by care practitioners. This nappy was made by London based lactation consultant Caroline Reid [47] and used as a demonstration tool. It shows different coloured areas as a guide for new parents to show the baby's poo as it transitions from meconium (black) to breastmilk poo (yellow) and formula milk poo (brown). In the UK, printed or digital charts with similar diagrams are also widely available, provided by the NHS and some nappy brands.*

* Words that are common in the UK for most parents, carers and health practitioners are being used in this paper. More accurate medical terms are less common in everyday language of care and might inhibit communication between parents and caregivers. This also applies when referring to intimate parts of the body.

experiences that can be adapted and directly related to their culturally and bodily situated perspectives, rather than set to fixed and excluding standards. They can also reflect the creative ways in which practitioners of care use and adapt a diversity of methods to support them and those they provide care for and are evidence of innovative uses of props, tools, making methods and materials. The proliferation of initiatives using creative practices such as drawing, journaling, crocheting, knitting or other forms of making, to support new mothers to help them explore and communicate their postnatal experiences [35, 36, 37, 38, 47] is also evidence of the power of creative practices for describing and exposing what is difficult to articulate through language [10].

Figure 10. Using the elbow to measure bath water

Touch

Midwives use their fingers to check the position of the baby's head as it begins to crown during childbirth

Midwives use their hands to locate the fundus, the top of the uterus

If the breast feels hard, hot or painful to the touch, it might be a case of mastitis, an infection of a milk duct

Touching the bath water with the elbow to check its temperature

Touching a child's forehead with the lips or the back of the hand to check temperature

A breast that feels full or heavy

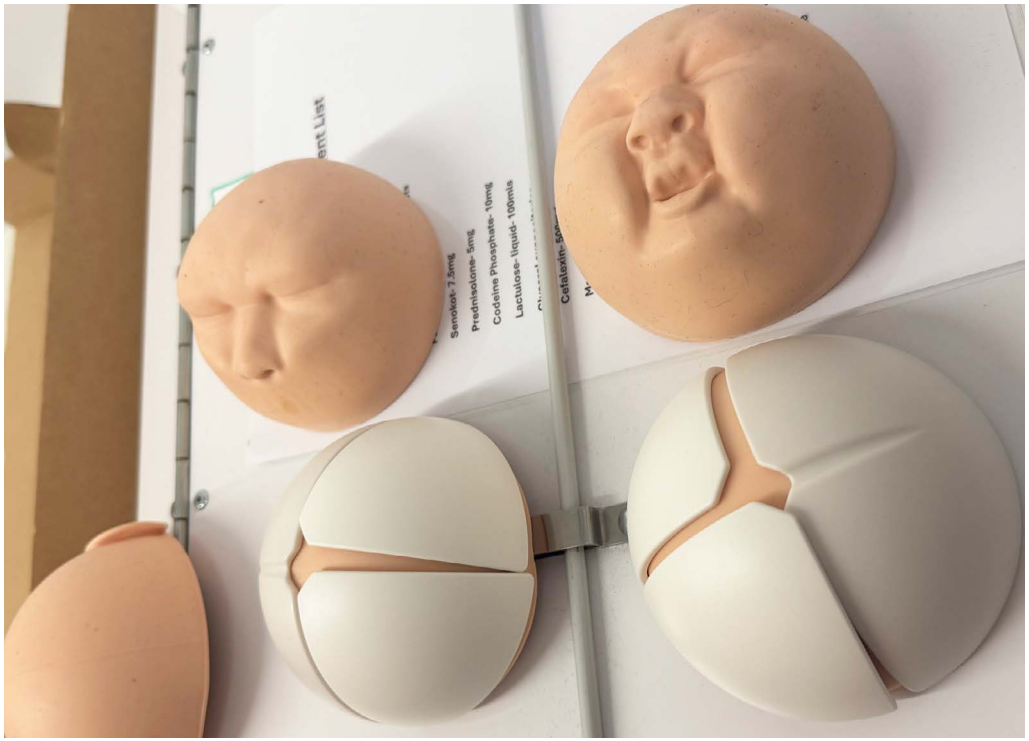

Figure 11. Midwifery training tools used to train fingers and learn about the baby's head position and its skull bones position as it crowns in the birth canal

Touch experiences play a significant role during the perinatal period. Skin-to-skin contact is beneficial for babies, parents and caregivers [5, 11, 27]. It releases oxytocin, encourages feeding, reduces stress, regulates temperature, heart rate and breathing and helps with bonding. Besides regulating biometrical parameters and providing pleasure to both caregiver and infant, touch has an important role is measuring wellbeing. For example, a way to evaluate if a breast is affected by mastitis is to check if it feels hot, hard or painful when touched, assessments that are made alongside the readings of a thermometer, as high temperature can indicate an infection. Midwives use their hands to assess the position of a baby's head as it enters the birth canal, using designed tools for training (figure 11). Touch is also often used to check the temperature of bath water (figure 10) for a baby's bath. Although often marginalised or dismissed as not sufficiently scientific, many sensorial practices coexist alongside readings created by machines. Breastfeeding pumps can measure the volume of breast milk it extracts, but other forms of measuring that are sensorial and make use of touch also play an important part: how heavy, hard or full a breast might feel to the touch or how fast the milk flows to satiate an infant's hunger are analogue ways to assess breastfeeding care.

Design responses and explorations

How could design address multimodal ways of reading the body and estimating wellbeing? As Cross observed [8], design practices can help both define a problem and suggest possible ways to develop suitable responses. The design responses shared in the following sections, form part of a range of sketched or semi-working prototypes that together form part of the research-through-design approach in this project. They are informed by observations, insights and examples gathered in the research but also from autoethnographic accounts, which have enabled me to dive into my own embodied experiences, also linked to social, cultural and biomedical contexts [15]. Paying attention to detailed aspects and questions about reading the body, these design explorations suggest potential, albeit untested, questions and design opportunities in the research space.

The pursuit of neutral, objective and standardised measurements can put excessive pressure on parents and caregivers. For example, breast pumps and their quantified measurements of milk extracted can produce expectations in mothers to perform to imagined standards [32]. A part in this research explores ideas about ways to read the body, through design considerations that might potentially be developed into tools or experiences to encourage parents and caregivers to notice, express or celebrate the individuality of their bodies and their babies.

Make your own belly scale

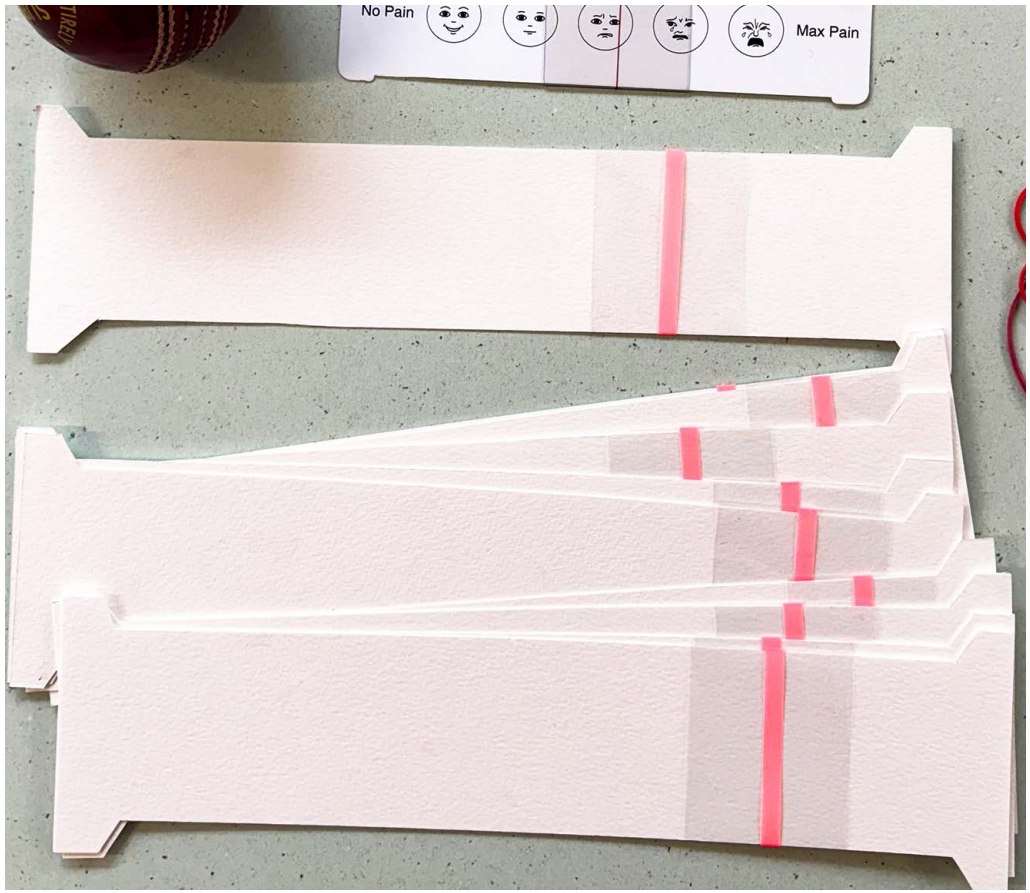

Figure 12. Make your own scale, blank template that users could write or draw on to describe their belly

Using some of the metaphors of material comparisons used to describe the belly during the perinatal period, blank templates were created as possible adaptable scales, using white card to draw, write upon or stick an image to, with a moveable vertical red line (shown in figure 12). This design exploration was partly informed by the existing pain scale cards used as a medical tool to communicate pain levels. They invite participants to create and visualise their own metaphors and measures for their pregnant or postpartum belly, using what might be familiar to them to illustrate how their bodies feel (for example, like jelly, a deflated or full balloon, bread dough, etc.).

More than... Measuring breast milk in fingers. Whose fingers?

Midwives, health visitors and feeding consultants teach mothers to observe their baby and decide when they seem satiated, and respond to early feeding cues. There is little emphasis on measuring and the focus is on reassuring mothers not to worry about the amount they produce as this is not a fixed amount. In supply and demand feeding, babies can change what they need depending on hunger, ambient temperature and illness, with milk components changing over time as the baby grows. The mother's diet, hydration, tiredness or stress can also affect their supply. However, the design of breast pumps with millilitre measurements on bottles, can impact the expectations that mothers might have to produce amounts of milk to imagined standards [32].

Figure 13 shows some early explorations with breast pumps, addressing how we might measure the body *with the body*, using fingers. If so, the question of whose fingers should be used as measurers arises. Perhaps stickers adaptable to different finger sizes as measuring guides could be included in the design or users could chose not to have any markings. This idea still relies on a form of measurement, but one that is not absolute and instead based on the lactating body's own and unique bodily units as points of reference.

Measurements are not always absolute: one litre of water in the Atacama Desert in Chile is of a different significance than one litre of water in Blackpool, England where it regularly rains [21]. Similarly, a spoonful of breastmilk is enough for a newborn but very little for an 8-month-old baby. Breast pumps could offer feedback to mothers with messages that could be loosely related to what was produced. Figure 13 also shows an exploration on possible ways to present such information. One question that arises is whether referencing amounts of milk with previous amounts produced by the same body could still produce expectations to perform to imagined standards or maintain the focus on measurements away from sensorial cues.

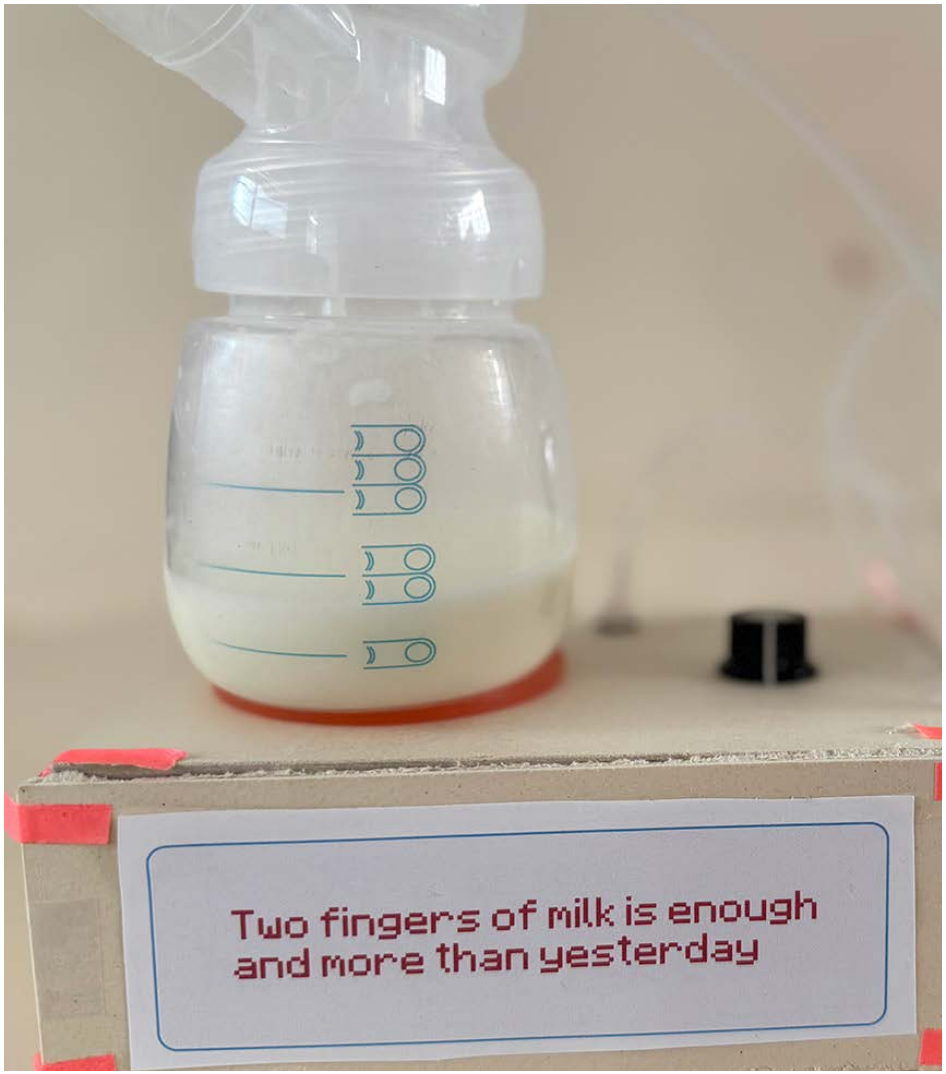

Figure 13. measuring the body with the body

Discussion

Somatic and subjective experiences in perinatal care are the result of entangled issues of biomedical, psychological, social, and cultural variables. Different stakeholders will understand and address different issues in diverse yet interdependent ways. The knowledge of midwives, health visitors, maternal and infant health practitioners, parents and carers during this period relies on both their own somatic experiences to train their senses to 'read' the situations they are working in, and on their own bodily ways of knowing that are often informed by their own personal experiences. This inevitably includes subjective ways of knowing. Many of the health practitioners that took part in activities during this research described their work with interwoven narratives having experienced both giving and receiving care for pregnancy and childbirth. In the UK, practitioners and receivers of perinatal care form part of a deeply diverse group, yet racial and social inequalities in childbirth and perinatal outcomes are severe [42]. Systemic biases towards racialised groups can affect their choices of and access to care, since assumptions about ethnicity can affect perceptions of bodies at higher risk. For example, home or natural birth choices are often assumed to be particularly important for white, middle-class women [24]. In the entanglement of assemblages of care, shaped by humans, non-humans and systems, optimistic narratives of technologies for perinatal care as absolute, neutral, objective and reliable forms of knowledge are problematic because they overlook biases that might be embedded in technological systems [7, 17, 28]. They also raise important questions about the authoritative role given to machines in situations that are often unique and changeable and where bodily forms of knowledge can become an important resource, if only to be confirmed or supported by technological interventions. As one midwife succinctly put it during a conversation in this research *'I rely on my senses, even when I read the foetal monitor'*.

The period of early parenthood is one of vulnerability, when most parents need to learn to accommodate to uncertainty and unpredictable outcomes, and where many integrate knowledge from practices done by their own parents or countries of origin with official medical advice from the place where they gave birth. To present machines as the primarily reliable tools for reading wellbeing can undermine the ability of both parents and caregivers to trust their own skills when reading a situation. Acknowledging the presence of biases in both human and in machine-led readings of the body can invite a careful examination of assumptions that can otherwise lead to discriminatory outcomes.

How should the body be read? As feminist scholars in design and HCI have pointed out, a pluralist view of the body can help deconstruct the idea of a universal user and instead acknowledge multiple and diverse bodies and subjectivities [4, 15, 17, 19]. This is particularly relevant during the perinatal period, when bodies are in a constant state of change: the infant, the pregnant or lactating body expands, contracts, leaks. In such a state of variability, an awareness of multiple ways of knowing can enrich collective forms of knowledge [17] and challenge socially constructed hierarchical and binary divisions between scientific readings and embodied, lived experiences [17]. The perinatal period has many of the characteristics of a wicked problem as coined by Rittel & Webber [29] and incorporated into design thinking by Buchanan [6]: bodies behave in multiple, diverse and changing ways so one solution cannot fit all bodies, babies are not puzzles to be solved and there is not a universal and objective way to read or 'translate' the body. As Cross observed [8], in design approaches to wicked problems not all the necessary information is available, and design responses can never have a guarantee of being the correct solution. Design approaches often both define the problem and suggest the nature of possible suitable responses to it [8]. Indeed, the design explorations, early, open-ended and unfinished responses shown in this pictorial are suggestions of potential directions that could address aspects in perinatal care and have been informed by multiple, subjective and embodied insights and reflections from stakeholders in this research and from myself. As Light and Akama suggest [18], design is always situated and our understandings of design comes from this situatedness. My involvement as facilitator and organiser of workshops, my responses as a designer in relation to the research space and my reflections on my and other stakeholders' experiences in perinatal care form a set of evolving research considerations, shared here. The primary aim of this pictorial paper is to address the extent to which design and technology contribute to social understandings of care, where both human and non-human ways of assessing wellbeing are deeply interwoven. The early design explorations shared here are intended partly as conversation starters about possible ways in which technologies could support bodily forms of knowledge and incorporate multiple ways of reading the body.

ACKNOWLEDGEMENTS

This paper could not have been created without the contributions through conversations, demonstrations and anecdotes shared by practitioners and researchers met during my research, and by all participants who took part in workshops.

Midwifery researcher and lecturer Dr Marina Daniele shared useful insights about the use of bodily senses alongside the use of monitors during perinatal care and facilitated a visit to learn about her teaching environment and demonstration tools, some of which are shown in this pictorial. I am grateful for her comments and suggestions during the writing of this paper.

Midwife and lecturer in health visiting Louise Mullins shared metaphors used for assessing wellbeing during the postnatal period and helped me organise and facilitate a participatory workshop with health visiting students.

Feeding consultant Caroline Reid shared useful insights about her use and making of demonstration tools, also shown in this pictorial.

The shared knowledge and insights from obstetrics researcher Professor Sally Collins, medical humanities scholar Dr Harriet Barrat, design researcher Dr Sally Sutherland, clinician Dr Liat Sarner, *Designing Motherhood* curator Amber Winick, soma design researchers Dr Madeline Balaam and Dr Caroline Yan Zheng were also valuable resources for the writing of this paper.

I am grateful for the suggestions and encouragement from lecturer and ceramicist Dr Kim Bagley, researcher in AI and Robotics Dr Maria Luce Lupetti, design researchers Dr Joe Lindley and Dr Matt Malpass, design and medical humanities researcher Dr Victoria Bates and designer and doctoral researcher Liliana Ovalle.

My research *Maternal Machines: Design Speculations about Fantasies of Care* is funded by a grant from the Wellcome Trust (reference 300080/Z/23/Z) from 2024 to 2028.

REFERENCES

1. Irina Aristarkhova. 2012. *Hospitality of the Matrix. Philosophy, Biomedicine and Culture.* Columbia University Press.

2. Les Back. 2015. *Why Everyday Life Matters: Class, Community and Making Life Liveable.* Sociology. 2015, Vol. 49(5) 820 –836

3. Jeffrey P. Baker. 1996. *The machine in the nursery*. Johns Hopkins University Press.

4. Shaowen Bardzell. 2010. Feminist HCI: taking stock and outlining an agenda for design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10). Association for Computing Machinery*, New York, NY, USA, 1301–1310. https://doi.org/10.1145/1753326.1753521

5. Anne E. Bigelow and Lela Rankin Williams. 2020. To have and to hold: Effects of physical contact on infants and their caregivers. *Infant Behavior and Development*.

6. Richard Buchanan. 1992. Wicked Problems in Design Thinking. *Design Thinking*. Vol 8, No 2.

7. Joy Buolamwini. 2023. *Unmasking AI*. Random House, "New York". https://www.penguinrandomhouse.com/books/670356/unmasking-ai-by-joy-buolamwini/

8. Nigel Cross. 1982. Designerly Ways of Knowing. *Design Studies*. Vol 3, issue 4

9. Patricia de Vries. 2020. The Speculative Design of Immaculate Motherhood. *Digitcult*, June 2020. https://digicult.it/design/the-speculative-design-of-immaculate-motherhood

10. Laura Devendorf, Kristina Andersen, and Aisling Kelliher. 2020. Making Design Memoirs: Understanding and Honoring Difficult Experiences. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20). Association for Computing Machinery*, New York, NY, USA, 1–12. https://doi.org/10.1145/3313831.3376345

11. Tiffany Field. 2003. *Touch*. MIT Press

12. Priscilla Ford, Susan Crowther, Nimisha Waller. 2023. Midwives' experience of personal/professional risk when providing continuity of care to women who decline recommendations: A meta-synthesis of qualitative studies. *Women and Birth*. Vol. 36, Issue 2

13. Sophie Hamacher and Jessica Hankey. 2023. *Supervision. On motherhood and surveillance*. The MIT Press

14. Claire Horn. 2023. *Eve*. Wellcome Collection Profile Books

15. Kristina Höök. 2018. *Designing with the Body. Somaesthetic Interaction Design*. MIT Press

16. Mafalda Gamboa. 2023. My Body, My Baby, and Everything Else: An Autoethnographic Illustrated Portfolio of Intra-Actions in Pregnancy and Childbirth. In *Proceedings of the Seventeenth International Conference on Tangible, Embedded, and Embodied Interaction (TEI '23). Association for Computing Machinery*, New York, NY, USA, Article 26, 1–14. https://doi.org/10.1145/3569009.3572797

17. Lauren Klein and Catherine D'Ignazio. 2024. Data Feminism for AI. In *Proceedings of the 2024 ACM Conference on Fairness, Accountability, and Transparency (FAccT '24). Association for Computing Machinery*, New York, NY, USA, 100–112. https://doi.org/10.1145/3630106.3658543

18. Ann Light and Yoko Akama. 2012. The human touch: participatory practice and the role of facilitation in designing with communities. In *Proceedings of the 12th Participatory Design Conference: Research Papers - Volume 1 (PDC '12). Association for Computing Machinery*, New York, NY, USA, 61–70. https://doi.org/10.1145/2347635.2347645

19. Donna Haraway. 1988. Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective. *Feminist Studies* 14, 3.

20. Roger Kneebone. 2021. *Expert*. Understanding the Path to Mastery. Penguin

21. Sebastián Lehuedé. 2024. *Lithium Extraction in the Atacama*. The Good Robot podcast. Dr Kerry McInerney and Dr Eleanor Drage

22. Kerry McInerney and Os Keyes. 2024. The Infopolitics of feeling: How race and disability are configured in Emotion Recognition Technology. *New Media & Society*, 0(0)

23. Anna Melamed. 2023. A post-structuralist feminist analysis of electronic fetal monitoring in labour. *British Journal of Midwifery*

24. Anna Melamed, Lucia Rocca-Ihenacho, Anna Horn, Christine McCourt, Frances Rivers, Marina Alice Sylvia Daniele. 2024. Facilitators and Barriers to Access to Midwife-Led Birth Settings for Racialized Women in the UK: A Scoping Review. *Birth Issues in Perinatal Care*. https://doi.org/10.1111/birt.12897

25. Mike Michael. 2012. Anecdote. In *Inventive Methods*. The happening of the social. Edited by Celia Lury and Nina Wakeford. Routledge

26. Michelle Millar Fisher and Amber Winick. 2021. *Designing Motherhood. Things that make and break our births*. The MIT Press

27. Mairéad O'Brien and Helen Lynch. 2011. Exploring the Role of Touch in the First Year of Life: Mothers' Perspectives of Tactile Interactions with Their Infants. *British Journal of Occupational Therapy*.

28. Inioluwa Deborah Raji, Timnit Gebru, Margaret Mitchell, Joy Buolamwini, Joonseok Lee, and Remi Denton. 2020. Saving Face: Investigating the Ethical Concerns of Facial Recognition Auditing. In *Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society (AIES '20). Association for Computing Machinery*, New York, NY, USA, 145–151. https://doi.org/10.1145/3375627.3375820

29. Horst Rittel and Melvin Webber. 1973. Dilemmas in a general theory of planning. *Policy Sciences 4* (2, Jun 1973), 155-169.

30. Richard Sennett. 2008. *The craftsman*. Yale Univ. Press, New Haven.

31. Margrit Shildrick. 1994. Leaky bodies and boundaries: feminism, deconstruction and bioethics. PhD thesis, University of Warwick.

32. Rei Yamada, K Rasmussen and Julia P. Felice. 2018. "What Is 'Enough,' and How Do I Make It?": A Qualitative Examination of Questions Mothers Ask on Social Media About Pumping and Providing an Adequate Amount of Milk for Their Infants. *Breastfeeding Medicine*. 2019 Jan/Feb;14(1):17-21.

33. Paulina Yurman, Matt Malpass, Madeline Balaam, Caroline Yan Zheng, Yoav Luft, Céline Mougenot, and Maria Luce Lupetti. 2025. Maternal Machines: Imagining Experiences in Perinatal Care. In *Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI EA '25). Association for Computing Machinery*, New York, NY, USA, Article 790, 1–6. https://doi.org/10.1145/3706599.3706744

34. Paulina Yurman. 2025. Drawing Maternal Machines and other Fantasies of Care. In *Proceedings of the Extended Abstracts of the CHI Conference on Human Factors in Computing Systems (CHI EA '25). Association for Computing Machinery*, New York, NY, USA, Article 627, 1–9. https://doi.org/10.1145/3706599.3716210

35. www.maternaljournal.org

36. www.instagram.com/bbbbookclub

37. https://maternalmentalhealthalliance.org/news/creative-practice-for-maternal-mental-health-wellbeing

38. www.all4maternity.com/postnatal-depression-and-art-therapy

39. Pan American Health Organization (World Health Organization). (2023). Traditional midwives Saving Lives by Combining the Knowledge of Ancestral and Western Medicines. https://www.paho.org/en/stories/traditional-midwives-saving-lives-combining-knowledge-ancestral-and-western-medicines

40. Maternal Machines: Design Speculations about Fantasies of Care (research funded by Wellcome, 2024-28) www.arts.ac.uk/maternal-machines

41. https://sites.google.com/view/imaginingmachines

42. Office for National Statistics. "Socioeconomic status". 2025. https://www.ethnicity-facts-figures.service.gov.uk/uk-population-by-ethnicity/demographics/socioeconomic-status/latest/#main-facts-and-figures

43. Rosi Braidotti. 2011. Mothers, Monsters and Machines. In Nomadic subjects. *Embodiment and sexual difference in contemporary feminist theory*. Columbia University

44. Mangham and Greta Depledge. 2011. *The Female Body in Medicine and Literature*. Liverpool University Press

45. Anneke M. Smelik, A. M. and Nina Lykke. 2008. *Bits of Life. Feminism at the Intersections of Media, Bioscience and Technology*. University of Washington

46. Judy Wajcman. 2004. *Technofeminism*. Polity

47. https://londonbreastfeeding.com/About-Me