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Sex/Gender: Part II: What's Fixed, Changeable, Changing?

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A Critical Moment: Sex/Gender Research at the Intersections of Culture, Brain, and Behavior

FPR-UCLA 2016 Conference Summary

Part 2 of the FPR-UCLA conference on sex/gender, which was chaired by cultural anthropologist **Gilbert Herdt**, explored aspects of brain and behavior that are "fixed" by evolution and biology and other aspects that create, reflect, and respond to human social and cultural environments. Speakers in the first session addressed, in Darwin's phrase, the "entangled bank" of biological, evolutionary, and cultural contexts of sex/gender differences in brain and behavior, while the second session offered a closer examination of "intimacies"– partnerships, marriage, sexual orientations, desires, and practices. A common theme throughout

was the instability of the sex/gender binary or, as Carol Worthman observed, the “loss of easy dichotomies” more generally. Perspectives varied widely depending on level of analysis, but there was a general willingness to “work with and speak across difference” (Worthman).

For neurobiologist Donald Pfaff, who presented experimental research focusing on autism, sex is a biological category/variable. Other speakers were more willing to extrapolate from biology, and in so doing, challenge what Sarah Richardson referred as our “essentialist” understandings. For social neuroendocrinologist Sari van Anders, even a “quintessential” male hormone like testosterone can be deconstructed (van Anders, 2013). Another common theme was gender-role and sexual fluidity, addressed from evolutionary (Fessler), hormonal (Rilling, van Anders), and situational/contextual (Diamond) perspectives. Finally, field research by anthropologists (Borgerhoff Mulder and Boellstorff) in non-Western and virtual settings underscored human flexibility and adaptiveness.

The talks revealed significant advances in our understanding of the underlying mechanisms and dynamic aspects of sex/gender-related behavior and their exquisite attunement to historically and culturally specific environments. As conference keynote speaker Anne Fausto-Sterling reminds us, “neither the body nor experience is prior, but each acts continuously upon the other as individual patterns of behavior and of neuronal connections appear” (Fausto-Sterling, 2014, p. 315).

Prenatal and perinatal factors, including maternal stress, profoundly influence brain and behavioral development. Neurobiologist Donald Pfaff (“Neuroendocrine Mechanisms Underlying Prenatal Stress in Effects and Sex Differences in Autism”) focused on one way in which iterative development can go awry. Autism Spectrum Disorders (ASD) involve motor, language, and social deficits, with the latter considered “the core concept” of the diagnosis. ASD is both highly heritable and sex-related (4:1 male-to-female ratio, increasing to 11:1 “with the highest levels of intellectual capacity”; Gillberg et al., 2006, as cited in Schaafsma & Pfaff, 2014). Pfaff and colleagues study the sex-differentiating factors underlying male bias in ASD.

Pfaff briefly outlined several non-mutually exclusive pathways to sex-differentiation in brain function that may have possible implications for sex-specific susceptibilities in or protection from ASD: (1) via Y-linked genes, such as *Sry*, which, as Art Arnold explained, has both direct and indirect (via gonadal hormones) effects – i.e., some are directly expressed in the brain and play a role in catecholaminergic functions; (2) X-inactivation “in the service of dosage compensation,” which can be balanced or skewed; (3) genetic imprinting – the epigenetic silencing of one of the two working copies of a gene inherited from parents; and (4)

other epigenetic-related factors (see Schaafsma & Pfaff, 2014, for more detail).

Male sex and the "3-hit" theory of autism"

Pfaff described the "3-hit" theory of autism as an interaction between: (1) androgenic hormones; (2) early stress; and (3) one of the genetic mutations associated with autism in males, such as the *CNTNAP2* mutation. Regarding Steps 1–2, testosterone affects arousal neurons in the forebrain; which results in greater activity in their ascending pathways, especially increased deposition of norepinephrine, dopamine, and serotonin in the amygdala. The amygdala becomes "supersensitive" and responds more acutely to social stressors, pre- and postnatally. Chronic overactivation in response to stress leads to social anxiety and ultimately the social avoidance characteristic of ASD.

Pfaff and colleagues use a mouse model to test exposures to prenatal stress/no stress on a 0–3 event scale in *Cntnap2* knockout and wild-type mice. (NB: They used maternal immune activation for prenatal stress because infection in pregnancy predisposes to autism.) The researchers found differences between the 0-hit and 3-hit mice based on three tests: ultrasonic vocalizations, social recognition (a series of home-cage exposures to an intruder mouse, followed by an exposure to a novel mouse), and social approach in a three-chambered cage. Interestingly, there was a slight *increase* in social approach for the 3-hit mice, and no differences in anxiety between wild-type no-stress females and the male mice in an open field test with various numbers of hits. The researchers sacrificed the animals and found significantly lower expression of mRNA receptors for stress-related corticotropin releasing hormone (CRH-R1) in the left hippocampus in the 3-hit mice. In the final piece of the story, the researchers harvested mRNA and found developmental sex differences in mRNA levels of connexin-36, which is important for mediating electrical synapses and promoting neuronal synchrony. Males express more connexin-36 in the amygdala than females, which has possible implications regarding the sex-related (male) amygdala hypersensitivity of the 3-hit model.

This emerging body of research focuses on the underlying neuroendocrine and epigenetic causes of the sex-related differences in ASD and also links the social behavior consequences (e.g., anxiety) to the number of "hits" over time, underscoring the iterative nature of sex-differentiation, a major theme of this conference.

Biocultural anthropologist **James Rilling** ("Neural, Hormonal, and Genetic Correlates of Human Paternal Behavior") shifted the morning's focus from mother–infant dyads to fatherhood. As Ruth Feldman (2015)

observed in a recent review, parenting may be the most delicately poised among all social phenomena between evolutionarily conserved components on the one hand and “the greatest plasticity” on the other. Fathers are less well studied, but Rilling’s research suggests significant plasticity in adult male as well as female brains in response to caring for offspring.

“Mothers and others”

Some biologists refer to humans as “cooperative breeders,” that is, the source of care and feeding of offspring comes from both “mothers and others” (Hrdy, 2009), albeit with significant cultural and interfamilial variation. According to Rilling, in modern Western societies that often consist of isolated nuclear families, fathers are often the greatest source of help to mothers. Emerging evidence indicates that paternal involvement is associated with “multiple positive developmental outcomes in children” in Western settings, he said.

Rilling’s talk addressed two questions: “Why is it that some men are more involved as fathers than others? Can we identify variables that are correlated with or influence paternal involvement?” His biocultural approach is based on an evolutionary and life-history perspective, more specifically for the purposes of his talk, on variation in and tradeoffs between investing energy in mating and in parenting.

Rilling’s research focuses on the hormonal (testosterone, vasopressin, oxytocin, and prolactin) and neural (mesolimbic dopaminergic pathway) mechanisms regulating behavior in fathers of young children (ages 1–3). In rats, the medial preoptic area (MPOA) of the hypothalamus, which is subject to the influence of steroid hormones, regulates parallel systems for pup approach/avoidance. Bathing the area in hormones activates the mesolimbic dopamine system (including the *ventral tegmental area* in the midbrain, the *nucleus accumbens* [part of the ventral striatum], and the *medial orbitofrontal cortex*), “a classic reward system pathway,” enhancing maternal motivation to nurture.

Rilling and colleagues recruited three groups of men: nonfathers, more involved fathers, and less involved fathers of children (ages 1–3) to study both hormone levels and brain function in response to visual child-related and sexual stimuli in order to explore tradeoffs between mating and parenting. Fathers had lower levels of plasma testosterone than nonfathers. They were also about 20 pounds heavier than nonfathers, putatively reflecting a significant negative correlation between testosterone and body fat. Fathers also had significantly higher levels of plasma oxytocin than nonfathers. In fathers baseline plasma oxytocin appears to enhance certain aspects of caregiving, such as stimulatory parent-infant

contact (Feldman, 2012; as cited in Young & Rilling, 2014).

Rilling and colleagues also compared the more and less involved fathers (using the Parental Responsibility Scale). They noted weak negative correlations between testosterone and instrumental caregiving and testes size and caregiving, although the relationship between testosterone and testes size was not statistically significant.

In terms of brain function, fathers viewed images of their own children (with happy, sad, and neutral facial expressions), unknown children, unknown adults, and sexually provocative stimuli. The investigators also primed an empathic response from the fathers by asking them to "try to share the emotions of the person in the picture." Across the board, fathers had stronger responses than nonfathers to the images of unknown children in such areas as the medial orbitofrontal cortex (part of the "reward" system) and the temporoparietal junction, which plays a putative role in theory of mind, or the ability to make inferences about the mental states of others. Across the board, the nonfathers had stronger responses to the sexually provocative visual stimuli, particularly in brain regions related to goal-related motivation and reward (e.g., the nucleus accumbens).

More involved fathers had higher activation of the ventral tegmental area (VTA), part of the network motivating approach to offspring in the rat studies, when viewing own children. There was also a more robust relationship – a negative correlation – between testes size and VTA response to viewing images of own children. Finally, fathers listened to infant cry stimuli, which among fathers notably activated the anterior insula (AI) bilaterally. Among other functions, the AI tracks sympathetic autonomic arousal. "Less involved" fathers had a lower or higher AI response, respectively, than fathers who were "most involved in instrumental caregiving" suggesting empathic under or over-arousal in the less involved group (Young & Rilling, 2014).

The final speaker of the afternoon, anthropologist **Monique Borgerhoff Mulder** ("Gender Roles in Mpimbwe: Re-evaluating Bateman's Gradient"), explored the effects of environment on intra- and extra-marital relations among the Pimbwe of the Rukwa Valley in western Tanzania. Her data challenge universalist gender roles drawn from standard sexual selection theory.

Due to conservation strategies, Pimbwe men can no longer legally hunt or fish in what is now Katavi National Park, and job scarcity makes education an unsatisfactory strategy for making a living in the Rukwa Valley. As a result, Pimbwe women are relatively powerful players within the marriage market. Not only do women control much of the gardening, environmental

factors – such as unreliable rainfall, agricultural pests, depredating wildlife, and theft from other villagers – have compelled them to engage in other economic activities that can help offset intermittent food shortages. "Under these tough economic, ecological, and environmental conditions marriage is problematic," Borgerhoff Mulder continued, and finding a good provider is critical. Marital decisions are particularly important because Pimbwe are increasingly unable to rely on cooperation from neighbors and kin (Kasper & Borgerhoff Mulder, 2015); cooperation with a marital partner becomes key, placing a lot of pressure on this relationship. Against this background Borgerhoff Mulder analyzes the considerable variability in gender roles and a strong prevalence for marital systems that are "very flexible." Monogamy, serial polygyny, and serial polyandry are common arrangements; extramarital affairs also abound (if a pregnancy results, it typically leads to marriage), and there is increasing polygyny.

"Why do Pimbwe men suffer from multiple spouses?"

Networks of various marriages (which the Pimbwe effectively define as pairs who cohabit), divorces, and extramarital mating patterns produce outcomes that provide an exception to Angus J. Bateman's (Arnold 1994) foundational claim that number of mates will have stronger effects on the fitness of males than females. This famous "Bateman's Third Principle" follows from his first two principles – that males will have higher variance in fitness (measured as number of surviving offspring) than females, and that males will have higher variance in the number of their mates than females. All of these differences are predicated on the fact that, by definition, males have smaller gametes than females.

Using longitudinal, cross-sectional, demographic, and economic data for all households in one village in the Rukwa Valley, Borgerhoff Mulder examined variation in reproductive success (Bateman's first principle) and mate number (his second principle), before modeling the effects on reproductive success of the number of an individual's mates (the third principle). Regarding reproductive success below age 40, the variance for men and women was "pretty similar." In accordance with Bateman's theory, as they aged beyond 40, men had a higher variance than women. Similarly mate number was equally variable between the sexes. But regarding Bateman's third principle, Borgerhoff Mulder found that having multiple spouses had a positive effect on mating success in women (i.e., production of surviving offspring) and a negative effect in men.

The Pimbwe challenge the "conventional view of promiscuous, undiscriminating males and coy, choosey females" (Brown, Laland, & Borgerhoff Mulder, 2009). Some Pimbwe women can "discard" – and benefit from discarding – husbands who are not good providers, in poor health, or just considered "lazy." According to Borgerhoff Mulder, these

women tend to be hard workers who can afford “to cycle through multiple marriages.” Despite the fact that some Pimbwe maintain successful polygynous marriages over a number of years, many Pimbwe men face the opposite fate. Reproductive success falters as they cycle through marriages, unable to keep their spouses from leaving them; they seem to make poor fathers. Borgerhoff Mulder theorized that the constant shift between multiple spouses by females, and the higher variance in mate quality that accompanies it, reflects the value system around pair bonding. That is, rather than aligning with conventional accounts, which suggest that in societies where divorce occurs, “pair bonds” must not be “very important,” Borgerhoff Mulder proposed the opposite: “Divorce may actually be an indicator of the importance of pair bonds” rather than their non-importance. That is, in societies where pair bonding is valued highly, stakes are higher, and therefore there is higher pressure to cycle through multiple spouses until the best one is found.

Evolutionary anthropologist **Dan Fessler** (“An Evolutionary Perspective on Sexual Orientation, Same-Sex Attraction, and Affiliation”) opened the second day of the conference with an evolutionary puzzle. Given the role of reproductive success in natural selection, “if there is any heritable contribution to sexual orientation, how have alleles for exclusive same-sex attraction persisted over evolutionary time?”

Human and animal studies find substantial heritability in sexual orientation, including same-sex attraction, which is most likely the effect of a number of genes and/or epigenetics, both of which are subject to natural selection. Existing (partial) explanations, such as pleiotropy or kin selection, focus on male homosexuality and “leave lots of variance unexplained.” Fessler focused on “overdominance,” or the “heterozygote advantage” of having *different* alleles of the same gene, theorizing that human sexuality is multifunctional. Here, Fessler was careful to distinguish between *sexual orientation* – “[culturally] patterned sexual desire that may lead to sexual behavior with members of one or the other sex” (Fleischman, Fessler, & Cholakians, 2015), which is closely related to gender, and *same-sex attraction*, his primary interest, which may or may not align with sexual orientation.

It is difficult to get precise numbers on same-sex sexual behavior; there are “huge” cross-cultural differences. For example, in some cultures same-sex sexuality is unknown, in others it is widespread, and in still others – as in the case of the Sambia – it is “required ritually.” He suggested that, “in the absence of norms prohibiting same-sex behavior, it apparently arises spontaneously,” often during sexual development.

Same-sex sexual behavior occurs across species, although regularity and context vary, and may have two primary nonreproductive functions: one

signifying affiliation (e.g., the alliance-enhancing same-sex bonds among the bonobos) and the other dominance (e.g., dogs mounting). Further, Fessler argued that “plasticity and flexibility” in sexual behaviors and corresponding attraction can be subject to natural selection. Returning to the concept of overdominance and particularly “multifunctional sexuality,” he cited work suggesting that same-sex sexual behavior supports the kind of alliance formation Herdt described in his talk. And note, he continued, that “this is compatible with existing evidence suggesting that sexual orientation and sexual psychology are separate things” in that the “target has shifted” to the same sex but the sexual psychology remains the same. Fessler also discussed the fitness-enhancing aspects of affiliative bonds. In nonhuman primates, “social bonds enhance survival and reproductive success.” Alliances were also vital in small-scale human societies for a number of reasons (for enhanced success in violent coalitional conflict, as a buffer against food shortfalls, to facilitate alloparenting, and as insurance against illness and injury), Fessler said.

“Where are all the bisexuals?”

Using Darwin’s finches as an example, Fessler showed how three allele pairs yield seven genotypes and a continuously distributed trait, or bell-shaped curve. He also noted the extent to which environment affects the expression of genes: “when the effect of each locus is small, environmental variation will blur genetic differences.” Given the multiple genetic contributions to same-sex arousal, the normal distribution of phenotypes would assume a bell-shaped curve, ranging from a committed same-sex phenotype with no reproduction “but lots of allies” to a committed opposite-sex phenotype with reproduction, but “fewer allies.” According to Fessler, most people would be “flexible” between the two. The “flexible” phenotype “accrues benefits of both same-sex contact and reproduction, depending on context.” Cultural pressures tend to shift normal distribution toward the right. His take-home message was that, aside from “obligate” same-sex and opposite-sex individuals on the far left and right of the bell curve, “for most people, the cultural context and the socialization experiences probably *do* profoundly influence their self-concept and their experiences of sexuality.”

The next speaker, social neuroendocrinologist **Sari van Anders** (“Social Neuroendocrinology, Gender/Sex, and Sexual Desire: Testosterone as Socially Constructed and Evolved”) emphasized the iterative or bidirectional relationship between hormones and behavior and, above all, the importance of context. Their dynamic interactions occur within “a space that is both social . . . and responsive to evolution.” Van Anders’s approach to “gender/sex” focuses on the interaction of the two constructs. “We can think of sex as relating to femaleness, maleness, and sexual diversity,” she said. “[S]ex falls into the part of the equation that is

evolution. And we can think of gender as falling into the part that is social context and that has to do with gender diversity, femininity, and masculinity. . . . [B]y gender/sex, I mean I'm studying whole men or whole women or whole gender/sex diverse people."

Van Anders stressed the importance of studying "human specificities," which often get overlooked, particularly the integration of *social constructions* ("shared cultural understandings that vary by place and time") and *biological constructions* (including contextually sensitive steroid hormones like testosterone), which modify one another. The remainder of her talk focused on testosterone and sexual desire. She described "testosterone" as both a biological material and a social construction. Her point is that "the stories we tell ourselves" about testosterone pretheoretically influence how scientific research is conducted. For example, one of the tacit assumptions of testosterone is that it promotes masculinity and is negatively related to femininity. Van Anders proposed a different model for understanding variability in testosterone based on a broader definition of sexuality that extends beyond reproduction. Her model (the Steroid-Peptide Theory of Social Bonds) suggests "an overarching social role [that is] similar in women and men," one in which low testosterone is linked to *nurturance* ("loving, warm contact") and high testosterone to *competition* ("acquiring and keeping resources"; see van Anders et al., 2011; van Anders, 2013; Goldey & van Anders, 2015), which brought to mind James Rilling's earlier talk on life history tradeoffs.

"There are many constructions of desire"

Van Anders discussed the concept of "sexual desire," taking apart some of its socially constructed assumptions (e.g., sexual desire is prototypically male, dyadic, orgasm-focused, and testosterone-fueled) and drawing out its extraordinary sensitivity to context and particular functions. A straightforward link between testosterone and sexual desire in men or women is tenuous at best. Instead, "there are many constructions of desire," which have both positive and negative correlations with testosterone. In her nurturance–competition model, nurturance/low testosterone is linked to closeness, pair bonding, and self-comfort, whereas competition/high testosterone is linked to erotic pleasure, power, orgasm, and jealousy. The idea is that "the expectations of erotic pleasure and orgasm actually can differ based on social location and sexual experience and other factors." For example, in heterosexual women, researchers found a negative correlation between dyadic sexual desire and testosterone, suggesting the women's "desire" is more closely related to nurturance than expectation of orgasm. The researchers found no correlation between sexual desire and testosterone in men, which also ran counter to our pretheoretical assumptions.

Next, developmental psychologist **Lisa Diamond's** talk ("Where Does Sexual Orientation Reside?") challenged the once-entrenched belief in a binary, innate, and stable distinction between same and other-sex "orientation" ("the general predisposition to experience sexual attraction"), beginning with the observation that individuals who are sexually oriented to the opposite sex are capable of having same-sex desires, and vice versa. Longitudinal studies have uncovered considerable "plasticity" or "fluidity" in same-sex and other-sex attractions and behavior (Diamond, 2012), particularly among women. Diamond defined sexual fluidity as "situational and contextual variability in the experience and expression of same-sex and other-sex sexuality over the life course." To address this greater complexity, Diamond conceptualized same-sex sexuality in terms of "*constitutional* same-sex sexuality" and "*facultative* same-sex sexuality." The former is rooted in "same-sex desires stemming from one's orientation." The latter refers to "same-sex desires facilitated by situational or environmental factors, which can vary significantly in women over time." Elsewhere, Diamond has argued that this variability "may constitute a fundamental feature of female sexual orientation" and may be particularly amenable to a dynamic systems theoretic approach (Diamond, 2012).

Diamond pointed out the difficulty of differentiating between constitutional same-sex sexuality (a "gold star lesbian") and a situational lesbian or "lesbian until graduation" on the basis of behavior. Even physiologically, "most women possess 'nonspecific' patterns of genital arousal" to same-sex and other-sex stimuli, "regardless of their own self-reported sexual orientation" (Diamond, 2012, p. 76; citing Chivers & Bailey, 2005; Chivers et al., 2004; Suschinsky, Lalumiere, & Chivers, 2009). (It's important to note that "women are more likely than men to show discrepancies between their physiological and subjective arousal [for review, see Chivers et al., 2007]," and these discrepancies are not well understood.)

Diamond's recent study looked at a different measure of desire: shifts in the responses of women of various self-identified orientations to sexual stimuli *during ovulation,* when estrogen levels peak. The diversity of responses by women of various sexual orientations suggests the need for a "biopsychosocial understanding" of how genetically influenced constitutions "interact with facultative environments, which range from microlevel processes – individual and dyadic relationships – to broad cultural environments, to produce different phenomenologies of desire, arousal, and behavior and then the pleasure that is taken from behavior." She characterized "each individual desire" as "its own phenotype because it represents a very specific and dynamic interaction between genetically influence processes, biologically mediated processes, and, obviously, socioculturally facilitated and embedded processes. . . .

[S]exual orientation is neither the genetic part of same-sex sexuality nor the socially categorized part," she continued, "If [we] want to make a distinction between constitutive and facultative desires, we have to understand the constellation of these different inputs and outputs over time."

Cultural anthropologist **Tom Boellstorff** ("Technology and Globalization: Emergent Intersections of Culture, Brain, and Behavior") discussed two long-term research projects focusing on globalization and technology: one on *gay*, *lesbi*, and *waria* Indonesians and the other on culture in virtual worlds (in particular, in the virtual world Second Life). Boellstorff began by remarking on the "inability to fuse or separate sexuality and gender," which reflects the broader issue of the nature/culture or biology/culture dichotomy that "still dogs us." For Boellstorff, "long-term engagement with a field site" in Indonesia "allows you to track forms of change . . . how forms of movement and mobility are shaping culture and shaping sexuality and gender." Both people and ideas are "moving." The language is incorporating new words (*gay, lesbi*) that suggest homogenization but also "new forms of difference." However, like sex/gender being "gay and Indonesian" or in most cases "gay and Muslim" "never fuse but they never become separate; "[i]t's about the juxtaposition that nonetheless becomes part of everyday experience." For example, *gay* and *lesbi* Indonesians are often married heterosexually – the two worlds needn't resolve into one, though forms of oppression shape these dynamics. The fragmented globalization of sexual identities is exemplified by the fact that the "coming out" metaphor is quite rare in Indonesia: the more common term, "opening" to the *gay*, *lesbi*, or heterosexual "worlds," has different implications for selfhood and community.

What is changing? Space and place

For Boellstorff, technology, and engagement with digital media in particular, serves as a means to challenge binary thinking, not only sex/gender, gay/straight, real/virtual, but also – as van Anders reminded us – biology/social constructions. His second research project is an ongoing ethnography of Second Life, a 3D virtual world whose members – via avatars – can fashion a less socially or physically encumbered identity, interact with one another in real time, immerse themselves in a range of social activities, and grow socially meaningful communities. In his 2015 preface to *Coming of Age in Second Life* (Princeton University Press, 2008), Boellstorff writes about an 85-year-old friend with Parkinson's who is also a Second Life resident. For Fran, both bodies are real – her physical body (with Parkinson's) and her virtual body, which "made it possible to wear a ball gown," whirl around a dance floor with Tom, and run a support group in a wooden cabin on Namaste Island for other

Second Lifers living with Parkinson's. Although Boellstorff urged the audience to look beyond the binarism of real/virtual worlds, neither do they resolve into one. Instead, he stressed their coexistence and equal importance to ethnography.

Overall, the transdisciplinary and interdisciplinary sex/gender perspectives in Part 2 challenged many of our theoretical presuppositions about what is fixed by nature and shed light on what is changeable and changing, including how we study sex and gender. As one of the speakers observed, bringing biology and culture together "makes for transformative science."

On Friday afternoon, FPR founder and president, Robert Lemelson, a documentary filmmaker and psychological anthropologist on the UCLA faculty, screened *Bitter Honey*. Shot over a seven-year period, the film explores polygamous marriages through the lens of three Balinese families (Sadra, Darma, and Tuaji). Next, filmmaker Kathy Huang presented her film (*Tales of the Waria*), which focuses focused on a group of biological men who self-identify as women—known locally as *waria* in Indonesia. Part III of our series reviews the two films in depth.

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