

The Desire Disorder in Research on Sexual Orientation in Women: Contributions of Dynamical Systems Theory

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Published online: 26 January 2012
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Abstract Over the past decade, numerous studies have documented fundamental differences between the phenomenology of male and female sexual orientation, largely centering on women's capacity for fluidity in their sexual attractions. The past decade has also witnessed fundamental changes in clinical perspectives on "normal" versus "dysfunctional" patterns of female sexual desire, largely centering on women's greater capacity for responsive and context-dependent sexual desires. In both cases, traditional male-based models of sexuality have been found inadequate to describe women's experiences. I argue that this inadequacy stems from a failure of traditional models to appropriately account for the phenomenon of *variability over time*, which may constitute a fundamental feature of female sexual phenomenology. I maintain that dynamical systems theory provides a useful and generative approach for reconceptualizing female sexual orientation, because dynamical systems models focus specifically on describing and explaining complex patterns of change over time. I review the key properties of dynamical systems models and provide an illustrative model of how this approach might yield new perspectives on female sexual orientation.

Keywords Sexual orientation · Sexual fluidity · Sexual dysfunction · Dynamical systems theory

Introduction

...most women may have nothing like a sexual orientation, if sexual orientation is conceived of as a well-

designed sexual mechanism that strongly motivates women to select sexual partners of one sex or the other (or both). (Bailey, 2009, p. 59)

Among the most robust conclusions arising from research on sexual orientation over the past several decades has been the fact that female and male sexual orientation represent strikingly different phenomena, characterized by different developmental courses, different underlying determinants, and different phenomenological manifestations (Chivers, Rieger, Latty, & Bailey, 2004; Hyde, 2005; Mustanski, Chivers, & Bailey, 2002). Whereas sexual orientation in men appears to operate as a stable erotic "compass" reliably channeling sexual arousal and motivation toward one gender or the other, sexual orientation in women does not appear to function in this fashion (for a review, see Bailey, 2009). Specifically, women are more likely than men to experience sexual arousal (assessed via genital responses to sexual stimuli) and desire (assessed via self-reports of sexual motivation) for both sexes rather than for one sex exclusively (Chandra, Mosher, Copen, & Sionean, 2011; Chivers & Bailey, 2005; Chivers et al., 2004; Chivers, Seto, & Blanchard, 2007; Laumann, Gagnon, Michael, & Michaels, 1994; Mosher, Chandra, & Jones, 2005; Savin-Williams, 2006) and both heterosexual and lesbian/isexual women report greater changes in their degree of same-sex and other-sex attractions over time than do heterosexual and gay/bisexual men (Kinnish, Strassberg, & Turner, 2005; Weinberg, Williams, & Pryor, 1994).

As a result of these phenomena, women's same-sex sexuality expresses itself differently from men's same-sex sexuality at every stage of the life course. For example, adult women appear likely to report sizeable discrepancies among their attractions, romantic feelings, and sexual behaviors; to report a markedly late and abrupt onset of same-sex sexuality, often after heterosexual marriage (Cassingham & O'Neil, 1993; Walsh, 2010); to report fluctuations in their sexual behaviors and identities over

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time, sometimes triggered by single relationships (see reviews in Bailey, Dunne, & Martin, 2000; Baumeister, 2000; Diamond, 2003b, 2007, 2008; Hyde, 2005; Mustanski et al., 2002; Peplau, 2001; Peplau & Garnets, 2000).

In light of these robust sex differences, some have gone so far as to argue that sexual orientation might not even *exist* in women (Bailey, 2009), whereas others have argued that it unfolds and operates in a less deterministic fashion for women than for men (Peplau, 2001) or interacts dynamically with a general propensity for female erotic plasticity or fluidity (Baumeister, 2000; Diamond, 2007). In essence, the “compass” analogy for sexual orientation does not work well for women: What, then, is the right model? Do women really lack a sexual compass? Or do they simply have a different type of compass? Or a weaker one? Or perhaps more than one?

I would argue that the key shortcoming of the compass model is its inability to account for *time* and *change*. The most distinctive feature of women’s same-sex sexuality, when compared to men’s same-sex sexuality, is its capacity for variability over time. This capacity is not captured by traditional, static models of sexual orientation which posit stable patterns of sexual arousal and desire. For such models, variability represents error. If one’s sexual compass reads “Kinsey 6,” then shifting toward Kinsey 4 means going off course. Accordingly, no meaningful information is to be gained from considering how and why the change occurred, over what time scale, and whether similar changes occurred previously or subsequently. In contrast, I would argue that information about the nature and determinants of change over time might prove just as important for understanding a woman’s sexual orientation as her average position on the Kinsey Scale. What we need, then, are conceptual models of female sexual orientation which treat women’s capacity for variability as a central rather than a peripheral phenomenon, and which seek to understand *both* stability and change in female sexuality.

Dynamical systems models are suited to this challenge. Dynamical systems models, originally developed by mathematicians and physicists to model the order and patterning of complex physical phenomena in the natural world (Kelso & Tuler, 1984), seek to explain how complex patterns *emerge*, *stabilize*, *change*, and *reestablish* over time, as a result of ongoing interchanges between individuals and their environments. Over the past decade, social scientists have increasingly applied this approach to complex human phenomena including cognition (Thelen & Smith, 1994), perception (Gilden, 1991), emotion (Fogel, Nwokah, Dedo, & Messinger, 1992; Fogel & Thelen, 1987; Izard, Ackerman, Schoff, & Fine, 2000; Magai & McFadden, 1995), and personality (Lewis, 2000; Read & Miller, 2002). Dynamical systems models focus specifically on understanding the processes and mechanisms underlying complex variability in human experience, including “increases in complexity over time, the emergence of true novelty within developing systems, [and] transition points that permit both structural advances and individ-

ual diversification” (Lewis, 2000, p. 40). In the domain of same-sex sexuality, these are the very phenomena which prove difficult to reconcile with the “compass” model. Hence, I would argue that by applying some of the concepts and methods of a dynamical systems approach, we can bring these perplexing forms of within-person variability back into the range of systematic analyses. Importantly, I am not offering dynamical systems theory as a fully-formed model of female same-sex sexuality, but a new approach to posing and answering questions about this phenomenon, one which centers on the complex processes generating stability, change, and transformation in sexuality over the lifespan.

Below, I review evidence drawn from research on sexual orientation *and* on female sexual dysfunction suggesting the critical importance of time and change to women’s sexual phenomenology (i.e., women’s first-hand conscious experiences of their sexual attractions, fantasies, desires, arousal, etc.). I then briefly review the principles of dynamical systems theory which are particularly well-suited to female sexuality, and I conclude by offering an example of how we might incorporate dynamical systems concepts into new models of female sexual orientation. Specifically, I suggest that we view female sexual orientation not as a stable point along the Kinsey scale, representing the “true north” of her erotic compass, but that we view it as a *waveform*: a pattern of regular oscillation around an equilibrium. Applying this model yields important new ways to conceptualize interindividual differences in female sexual orientation. Specifically, in addition to asking about a woman’s sexual equilibrium (i.e., whether her attractions are generally in the Kinsey 6 range or the Kinsey 4–5 range), we might also consider the *degree of variation* she typically experiences over time and *over what span of time*. These are precisely the types of questions which are central to a dynamical systems approach. Furthermore, as I review below, recent research challenging conventional perspectives on female sexual dysfunction increasingly suggests that variability over time is not only a fundamental component of female sexual orientation, but of female sexual desire more generally, underscoring the relevance of a dynamical systems approach.

The Role of Change in Female Sexual Orientation

The defining feature of a dynamical systems approach is its attempt to systematically model change over time in an organized system (for review, see Granic, 2005). Hence, in order to demonstrate the relevance of dynamical systems theory to female sexual orientation, I begin by highlighting the fundamental importance of *change* in female same-sex sexuality and female sexual desire more generally.

As noted earlier, traditional models of sexual orientation presume longitudinal continuity in its expression over the life course (for review, see Diamond, 2008). According to this view,

individuals who are currently exclusively attracted to the same sex have always been exclusively attracted to the same sex, and they will show the same pattern in the future. Yet, numerous studies have found that some individuals, more often women than men, report notable shifts in same-sex attractions, fantasies, and behaviors over time (Golden, 1996; Kinnish et al., 2005; Kitzinger & Wilkinson, 1995; Weinberg et al., 1994). The most convincing evidence comes from longitudinal data. For example, Pattatucci and Hamer (1995) collected 18-month follow-up data from 175 lesbian, bisexual, and heterosexual women recruited from lesbian/gay/bisexual organizations and (for the heterosexual women) Women's Studies programs at several universities. Pattatucci and Hamer averaged respondents' Kinsey ratings of sexual attraction, fantasy, behavior, and found that over the 18 month assessment period, about 20% changed their Kinsey classification. Stokes, Damon, and McKirnan (1997) and Stokes, McKirnan, and Burzette (1993) followed 216 bisexual men over a 1-year period, and found that over 45% changed Kinsey ratings. Longer follow-ups were conducted by Weinberg et al. (1994), who assessed change over a 5-year interval among, gay, lesbian, bisexual, and heterosexual men and women; approximately two-thirds of men and women reported changes of one point or more in their sexual attractions (more than half of which were in a same-sex direction), and over 80% of men and women reported changes of one point or more in their sexual behavior (half of which were in a same-sex direction). The proportions of women and men undergoing change were comparable.

Dickson, Paul, and Herbison (2003) sampled a cohort of approximately 1,000 New Zealanders born in the early 1970s. They found that over a 5-year period, nearly 30% of the men and 45% of the women who reported *ever* having experienced same-sex attractions underwent a shift in their attractions between age 21 and 26. My own longitudinal research has found that over a 10-year period, over two-thirds of sexual-minority women changed their sexual identity labels, with between 25 and 30% changing labels within each 2–3 year period (Diamond, 2008). A similar percentage of respondents (in this case, a sample of 156 urban, predominantly ethnic-minority youth) reported identity changes over an 18 month period (Rosario, Schrimshaw, Hunter, & Braun, 2006).

Importantly, change in same-sex and other-sex attractions and behavior does not appear to be confined to sexual-minority populations. In Pattatucci and Hamer's (1995) study, 27% of the women who had described themselves as Kinsey 0 (i.e., heterosexual) at the first assessment switched to Kinsey 1 at the 18-month follow-up, and 15% of the women who had described themselves as Kinsey 1 at the first assessment switched to Kinsey 0 at the 18-month follow-up. In Weinberg et al.'s (1994) study, 20% of the heterosexual women and 15% of the heterosexual men reported (retrospectively) that their Kinsey rating of sexual attraction or behavior had changed (in a same-sex direc-

tion) over a 3-year period. In the study by Kinnish et al. (2005), the average change in Kinsey scale ratings among heterosexual women was 1 point for sexual fantasy ($SD = 1.7$), .6 points for romantic attraction ($SD = 1.3$) and .5 points for sexual behavior ($SD = 1$). Among men, these change scores were (respectively) .5 ($SD = 1.1$), .3 ($SD = .8$) and .4 (.9). Heterosexual women's changes were significantly larger than heterosexual men's changes. In the study by Dickson et al. (2003), 5% of men and 8% of women who reported that their current attractions were exclusively heterosexual indicated that they had experienced same-sex attractions in the past.

All of the aforementioned studies have found larger changes in sexual attractions and behavior among women than among men, and in light of such findings several researchers have argued that women's sexuality may be intrinsically more "plastic" or "fluid" than men's (Baumeister, 2000; Diamond, 2008; Peplau, 2001), meaning that women's desires are particularly sensitive to situational or interpersonal factors, making it possible for a woman to develop sexual desires and to enjoy sexual behavior that run counter to her overall orientation (it bears noting that these models presume that such changes are *not* artifacts of distorted reporting, potentially brought about by force or social pressure, but are experienced by women themselves as authentic erotic experiences). Female sexual fluidity provides a possible explanation for the fact that women have historically been more likely than men to ascribe a role for choice, circumstance, chance, and change in their sexual orientation and identity over the life course (Golden, 1996; Whisman, 1996). Gagnon (1990), for example, observed over many years of research on female and male sexuality that women's participation in same-sex sexuality sometimes appeared to come about "by accident," significantly shaped by nonsexual factors. Beginning with the feminist movement of the 1970s and extending decades afterwards, researchers have observed that women's immersion in feminist politics, coupled with the development of strong same-sex friendships and exposure to lesbian–gay–bisexual peers, often proved to be powerful triggers for new and unexpected same-sex attractions and fantasies (Cass, 1990; Golden, 1987, 1994; Shuster, 1987).

Contemporary culture provides an altogether different set of gender-specific contexts that provide potential triggers for same-sex sexuality. In particular, the past decade has witnessed a notable increase in television and film portrayals of heterosexually-identified women engaging in experimental same-sex behavior, usually with few negative social consequences (for reviews, see Diamond, 2005a; Thompson, 2007). The phenomenon has become common enough to give rise to its own descriptor: *heteroflexibility* (Essig, 2000; Savage, 2002). Along the same lines, Morgan and Thompson (2007) and Thompson and Morgan (2008) have noted that many contemporary young women use the identity term "mostly straight" or "bi-curious" to denote the fact that they are open to the possibility of same-sex contact, even if they consider their basic orientation to be heterosexual.

The Importance of Nonexclusivity

To some degree, propensities for change in same-sex and other-sex attractions may be fundamentally linked to the phenomenon of *nonexclusive* (i.e., “bisexual”) patterns of attraction. As noted by Weinberg et al. (1994) in their groundbreaking study of bisexually-identified men and women, nonexclusive patterns of attraction appear to lend themselves to variation over time, as individuals move into and out of different environments and relationships, activating different aspects of their erotic capacity. Hence, whereas one does not generally expect to see substantial oscillations between same-sex and other-sex desire among individuals that are exclusively gay/lesbian or exclusively heterosexual, such oscillations would appear to be par for the course among individuals who are consistently attracted to *both* men and women.

It is, therefore, particularly notable that women are far more likely to report sexual attractions to both sexes than to report exclusive same-sex attractions, and that women are more likely than men to report nonexclusive attractions (Bailey et al., 2000; Garofalo, Wolf, Wissow, Woods, & Goodman, 1999; Kirk, Bailey, Dunne, & Martin, 2000; Laumann et al., 1994; Mosher et al., 2005; Remafedi, Resnick, Blum, & Harris, 1992; Savin-Williams, 2006). For example, one recent representative study of over 13,000 American adults (Chandra, Mosher, Copen, & Sionean, 2011) found that 13% of American women were attracted to both sexes, whereas less than 1% were exclusively attracted to the same sex. Among men, these percentages were 6% and 1.5%. In other words, about twice as many men as women report exclusive same-sex attractions, whereas twice as many women as men report nonexclusive attractions. Notably, the majority of individuals reporting nonexclusive attractions in the aforementioned studies are predominantly attracted to the other sex; hence, individuals with nonexclusive attractions should not be presumed bisexual, or “Kinsey 3’s” (i.e., equally attracted to the same sex and to the other sex). Rather, most report being more attracted to one sex than the other; their key defining characteristic is the coexistence of same-sex and other-sex attractions.

Similar findings have emerged from assessments of women’s physiological responses. Numerous studies (Chivers & Bailey, 2005; Chivers et al., 2004; Suschinsky, Lalumiere, & Chivers, 2009) have demonstrated that most women possess “nonspecific” patterns of genital arousal, such that they become aroused to *both* same-sex and other-sex stimuli, regardless of their own self-reported sexual orientation. This effect has been replicated in a variety of studies using other psychophysiological and behavioral measures of sexual arousal, such as electroencephalograms, functional magnetic resonance imaging, and the length of time that individuals look at erotic picture (Costa, Braun, & Birbaumer, 2003; Costell, 1972; Hamann, Herman, Nolan, & Wallen, 2004; Wright & Adams, 1999). Men, in contrast, tend to report highly gender-specific patterns of sexual arousal that correspond

closely to their self-reported sexual orientation (one notable exception to this pattern is that although lesbians’ genital responses to depictions of sexual activity are nonspecific, their responses to images of solitary nude figures are category-specific, such that they show substantially more arousal to female than male bodies) (Chivers, Seto, & Blanchard, 2007). Another key finding from this body of research is that women are more likely than men to show discrepancies between their physiological and subjective arousal (for review, see Chivers et al., 2007). Notably, these discrepancies take multiple forms. In some cases, women report much greater subjective than genital arousal. In other cases, they show the opposite pattern, and the direction of the discrepancies does not correspond systematically to women’s self-described sexual identity.

It may be tempting to treat genital or neurobiological measures as “truer” measures of an individual’s sexual orientation than his/her own subjective report (and, in fact, some researchers have directly advocated this approach to male sexual orientation) (Bailey, 2009). Yet, the reasons for discrepancies between women’s subjective and physiological arousal are not well-understood, and have generated considerable empirical and theoretical attention in their own right (Chivers & Bailey, 2007; Chivers, Seto, Lalumiere, Laan, & Grimbos, 2010; Laan & Janssen, 2007; Suschinsky et al., 2009). The more important point is that women’s propensity for nonexclusive desire and nonspecific arousal is manifested across *multiple* components of the overall sexual response system. Intriguingly, as pointed out by Chivers et al. (2007), Goy and Goldfoot (1975) noted over 30 years ago that in many different mammalian species, bisexuality is an intrinsically dimorphic trait which develops (through prenatal hormonal pathways) in *either* the male or the female of a species, but never both. This suggests the provocative possibility that, in humans, women are “the more bisexual sex,” whereas males are more likely to be exclusively heterosexual or homosexual (see also Bailey, 2009; Rieger, Bailey, & Chivers, 2005). If so, this would imbue women with an intrinsic potential for ongoing dynamic *change* in sexual experience over the life course, whereas male sexuality should be more fixed.

Even among women with relatively exclusive patterns of same-sex or other-sex attraction (i.e., Kinsey 6’s or Kinsey 0’s), dynamic changes in sexual arousal and desire may remain fundamental components of female erotic phenomenology. Over the past decade, debates over definitions of female sexual dysfunction, particularly hypoactive sexual desire disorder (i.e., low or absent sexual desire), have given rise to important reconsiderations of the female sexual response cycle which place greater emphasis on women’s erotic *responsiveness* to contextual and interpersonal factors (Basson, 2000, 2001, 2002; Everaerd & Laan, 1995). Hence, just as a capacity for context-dependent variability may be a fundamental component of female sexual orientation, this capacity also appears to be a fundamental component of female sexual arousal more generally. A brief review of current literature on the responsive, dynamic aspects of female

sexual arousal provides additional evidence for the relevance of dynamical systems models for modeling female sexual orientation.

Lessons from Research on Sexual Dysfunction

Historically, research on sexual orientation has focused only on the *targets* of individuals' sexual desires, setting aside basic questions about the nature and phenomenology of desire more generally. In contrast, research on female sexual dysfunction has devoted considerable attention to the basic determinants and phenomenology of sexual desire, given that low or absent sexual desire is the single most common form of female sexual dysfunction (Laumann, Paik, & Rosen, 1999), with prevalence estimates varying from 20 to 50% in studies conducted worldwide (Fugl-Meyer & Fugl-Meyer, 1998; Johnson, Phelps, & Cottler, 2004; Kang, Laumann, Glasser, & Paik, 1998; Paik & Laumann, 1998). Among the most important recent developments in the clinical literature on female sexual function and dysfunction has been the movement away from traditional, male-based models of sexual response toward models designed to account for women's distinctive experiences (Basson, Wierman, van Lankveld, & Brotto, 2010; Brotto, Bitzer, Laan, Leiblum, & Luria, 2010). Conventional models of sexual response (Kaplan, 1979; Masters & Johnson, 1966) posited that the sexual response cycle began with an experience of innate and automatic desire, which progressed to sexual arousal and motivated subsequent sexual behavior and release. Basson (2000, 2001, 2002) argued that this model overemphasized the role of "automatic" desire (which is reported far less frequently among women than among men) and underemphasized the role of interpersonal and contextual factors in triggering and augmenting women's desires. Basson maintained that, for women, desire is a fundamentally responsive system, typically experienced *after* encountering a erotic stimulus within a sufficiently facilitative context (see also Both, Spiering, Everaerd, & Laan, 2004; Everaerd & Laan, 1995; Everaerd, Laan, & Both, 2001; Laan, Everaerd, van der Velde, & Geer, 1995). This is not to say that women never experience spontaneous urges to initiate sexual behavior (i.e., urges that are not triggered by encountering sexual stimuli), only that such spontaneous urges are less common than responsive desires, which are shaped by a range of diverse contextual and interpersonal factors.

Although Basson developed this model in the context of clinical research on sexual dysfunction among heterosexual women, her model has important implications for female sexual orientation because of its emphasis on sexual desire as a *variable* and *responsive* system. Just as conventional models of sexual desire (based on men) have posited sexual desire as a relatively stable drive providing a stable motive for sexual activity, conventional models of sexual orientation (also based on men) have posited sexual orientation as a relatively stable "compass" providing a stable motive for same-sex behavior. Yet, if female

sexual desire is fundamentally responsive and context-sensitive, then it should vary across different situations and interpersonal contexts, making it difficult to produce a comprehensive account of a woman's sexual phenomenology without observing how her desires change in response to contextual factors. In the context of sexual dysfunction, this implies that the absence of spontaneous sexual urges is not sufficient to diagnose a woman with hypoactive sexual desire disorder. One must instead assess how she responds to sufficiently arousing contexts and stimuli. Applied to the realm of sexual orientation, one might similarly argue that the absence of spontaneous same-sex attractions (or, for that matter, other-sex attractions) is not sufficient to "diagnose" a woman's sexual orientation. Rather, one must assess how she responds to a range of different arousing contexts and stimuli, across different situations and over time.

This provides an important new way to understand the abrupt emergence of novel same-sex desires in adult women, often as a result of becoming intimately emotionally attached to a same-sex friend (Cass, 1990; Cassingham & O'Neil, 1993; Diamond, 2000a, 2002; Kitzinger & Wilkinson, 1995; Penelope & Wolfe, 1989; Pillard, 1990; Shuster, 1987; Stanley & Wolfe, 1980). According to traditional models of sexual orientation, the sudden "appearance" of same-sex desire makes no sense. After all, if sexual orientation is an ever-present, intrinsic compass, its effects should remain consistent over time. Yet, if we apply Basson's model of female sexual desire to female sexual orientation, and take more seriously women's capacity to experience significant changes in desire due to their responsiveness to contextual factors, then the sudden "appearance" or "disappearance" of same-sex (or other-sex) desires at different points along the life course, especially due to her experience within an intimate interpersonal relationship, no longer appears problematic, but instead quite expectable.

Notably, Basson (2002) has characterized the female response cycle as "fragile," suggesting that because of its capacity for change and because of its sensitivity to contextual factors, experiences of arousal and desire may be easily interrupted. Again, this perspective yields fruitful applications to sexual orientation: if women's experiences of desire and arousal are "fragile" and prone to discontinuity because of their context-sensitivity, then so too might be the phenomenology of female sexual orientation. A woman's capacity for same-sex desire might be consistent, but her conscious experience of same-sex desire might be highly variable, changing as she moves into and out of different intimate relationships with women and men, and into and out of environments that provide differing degrees of access to (and support for) same-sex and other-sex erotic stimuli. This does not imply that she lacks a sexual orientation, only that its manifestations are necessarily variable and dynamic, due to the responsive nature of female desire.

Hence, Basson's critical insights about the responsive, context-sensitive nature of female sexual desire suggest that variability is a normative and expectable feature of women's erotic

phenomenology, and hence the phenomenology of female sexual orientation. Below, I outline the usefulness of dynamical systems theory for modeling this variability, and I suggest a potential alternative to the “compass” model.

Applying a Dynamical Systems Approach

Dynamical systems models are ideally suited for modeling female sexual orientation because they focus specifically on the underlying dynamics of *complex variability* in human experience over time. Dynamical systems approaches to social-behavioral phenomena belong to a larger family of theoretical perspectives seeking to replace deterministic models with an emphasis on dynamic person-environment interactions occurring over time (for review, see Granic, 2005). There are actually several different types of dynamical systems models (van Geert & Steenbeek, 2005), but at their core they all emphasize transformative, bidirectional, changing interactions among endogenous factors (such as genes, hormones, skills, capacities, thoughts, and feelings) and exogenous factors (such as relationships, experiences, cultural norms, family history, etc.). According to dynamical systems theory, interactions among these elements can actually create novel psychological and behavioral phenomena during periods of fundamental reorganization in the overall system, denoted “phase shifts” (Granic, 2005). Phase shifts occur when certain parameters governing the system, or certain relationships among parameters, start to vary outside of certain critical thresholds (Fogel & Thelen, 1987). As a result, existing patterns of thought and behavior break down and new patterns take their place. As described by Granic (2005), “Phase transitions are points of increased sensitivity, when small fluctuations or perturbations have the potential to disproportionately affect the interactions of multiple system elements....After the period of flux, developmental systems restabilize and settle into new habits” (p. 401). Thus, phase shifts demonstrate the capacity for dynamical systems to oscillate between periods of stability and change depending on the circumstances. This is what Fogel and Thelen (1987) described as “dynamic stability” (see also Thelen & Smith, 1998).

This overall process is denoted *self-organization*, defined as the spontaneous development of order within a complex system (Kelso, 1997). A closely related concept is *emergence*, defined as the coming-into-being of altogether novel behaviors or experiences through dynamic, unpredictable interactions among different elements in the system. In emphasizing processes of self-organization and emergence, dynamical systems approaches stand in direct contrast to essentialist, organismic models of development which presume that complex behaviors or experiences unfold gradually and progressively according to innate, deterministic programs. Whereas the organismic approach predicts relatively uniform trajectories with consistent onsets and outcomes, dynamical systems approaches maintain that devel-

opmental pathways are necessarily idiosyncratic, tweaked by long cascades of diverse interchanges between individuals and their changing environments. This does not mean that development is endlessly, inevitably variable. Rather, stability reliably emerges as new patterns of thought and behavior are repeated and reinforced via internal feedback mechanisms. Yet such stability is necessarily *dynamic*, meaning that it continues to be susceptible to ongoing change and realignment as a function of changing environments and situations (Fogel & Thelen, 1987). Different psychological and behavioral patterns have different degrees of dynamic stability. Some are relatively resistant to environmental perturbations, whereas others are “softly assembled” (Thelen & Smith, 1998), meaning that they tend to be more prone to reorganization when changes occur in the constituents of the system or in the local environment.

The capacity to reconcile both stability and change is a critical feature of dynamical systems approaches. In the domain of sexuality, a dynamical systems approach would predict that the diverse constellation of changing contexts faced by a particular woman will produce *local variability* in her same-sex and other-sex attractions over short- and medium-term stretches of time. Yet over the long-term, a variety of constraining influences (ranging from genetic factors to cultural norms to straightforward habits) should channel individuals toward certain regular, but nonetheless flexible, pathways over the long term (for a more detailed discussion of the notion of dynamic stability in regards to female sexuality, see Diamond, 2007).

This yields an utterly different conceptual approach to female sexual orientation than the “compass” model, one which attempts to simultaneously account for local variability and global stability. Recall that the compass model posits that each person’s orientation functions as a sort of “true north,” pulling them consistently in a specific direction. Although individuals’ behaviors might periodically deviate from their orientation due to situational or cultural factors (i.e., local variability), the orientation itself should show consistency across situations and over time: no matter where or when you pull out your compass, “true north” remains true.

Yet, if we incorporate dynamical systems concepts of complex variability and self-organization, we might find that a more appropriate analogy for female sexual orientation is a *waveform*. The key difference between the compass and the wave is variability over time. In the compass model, orientation is a fixed point. In the waveform model, orientation comprises a range of variability, constrained by an individual’s propensity for sexual fluidity and his/her exposure to different facilitative environments and relationships. Hence, although individuals are still presumed to possess a relatively consistent sexual predisposition for the same-sex, the other-sex, or both sexes (analogous to Bailey’s compass), in the waveform model, this predisposition functions as an *equilibrium* point rather than “true north.” Accordingly, women can be expected to show regular oscillations around this equilibrium point. For women with a strong

capacity for sexual fluidity, these oscillations will be large and more frequent. For women with a weaker capacity for sexual fluidity, they will be smaller and less frequent. According to this model, the only way to meaningfully assess a woman's sexual orientation is to measure her sexual phenomenology repeatedly, across different spans of time and different interpersonal and situational contexts.

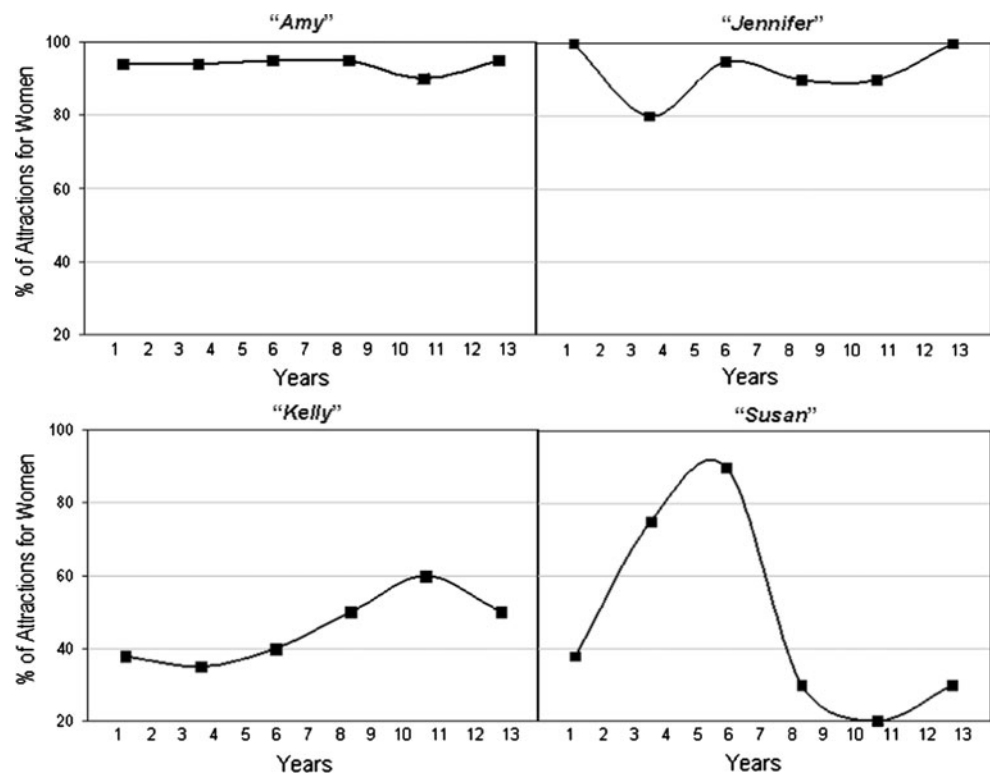
Example: Waves Instead of Points

As an illustration, consider the data represented in Fig. 1, collected from four participants in my ongoing longitudinal study of sexual identity development (Diamond, 1998, 2000b, 2003a, 2005b, 2008). Each woman has reported, 6 separate times over a 13-year period, the percentage of her day-to-day sexual attractions directed to women versus men. The two women on the top half of the figure ("Amy" and "Jennifer") had the same average percentage of same-sex attractions over the 13-year assessment period: 93%. Yet, they clearly have strikingly different patterns of variation over time. Amy showed a fair degree of stability over time (the SD of her ratings was 3 percentage points). Jennifer, in contrast, showed a much higher degree of variability from assessment to assessment, ranging from 100% same-sex attractions to 80% same-sex attractions (with an SD of 8 percentage points). Obviously, calling each woman a "Kinsey 5" based on her average degree of same-sex attraction would fail to accurately represent their respective sexual profiles, since it

would entirely disregard each woman's distinct pattern of variation over time. The same was true of "Kelly" and "Susan," on the bottom half of the figure. Again, each woman has the same average percentage of same-sex attraction over the 13-year assessment period: 47%. Yet, Kelly showed much less variation over time (SD = 9 percentage points) than did Susan (SD = 28 percentage points). "Bisexual" or "Kinsey 4" might be a reasonable description of their overall patterns of attraction, but again would provide only a partial picture of each woman's distinct phenomenology.

This is where a waveform approach could prove useful, as it would yield multiple parameters on which these women could be compared. The first and most obvious is the *equilibrium* point, representing a woman's average percentage of same-sex attractions over time. This element was identical for Amy and Jennifer (93%) and for Kelly and Susan (47%). Yet, of course, the very notion of an equilibrium point presumes that variation will occur around that point, and we can represent this variation in terms of the *amplitude* and *frequency* of the waveform. Amplitude represents the distance from the wave's equilibrium point to its "crest" (the highest point) or trough (lowest point). Amplitude is traditionally conceptualized as the amount of "energy" in a waveform, and provides one way to represent the degree to which a woman's sexual fluidity (coupled with variations in her environment and her relationships) alters her ongoing sexual phenomenology. Jennifer and Sarah have large amplitudes, which may suggest that they possess relatively stronger capacities for sexual fluidity than do Kelly and Susan,

Fig. 1 Patterns of variability in four women's self-reported percentage of same-sex attractions over a 13-year period



or that they have simply experienced more variability in their environments and relationships over time. Finally, there is the *frequency* of each waveform, representing how many distinct cycles of variation (i.e., deviating from, and then returning to, her equilibrium point) she undergoes during a given span of time (a related construct is the *period* of each woman's cycle, which is the total amount of time it takes for her to undergo a complete cycle; period and frequency are reciprocals of one another). A key difficulty in accurately representing each woman's frequency and period is that these parameters are highly sensitive to the scale of measurement. The waveforms in Fig. 1 are measured at the scale of years. Yet, what if the true period of Kelly's waveform is 9 months? By waiting too long between assessments, we will fail to capture this.

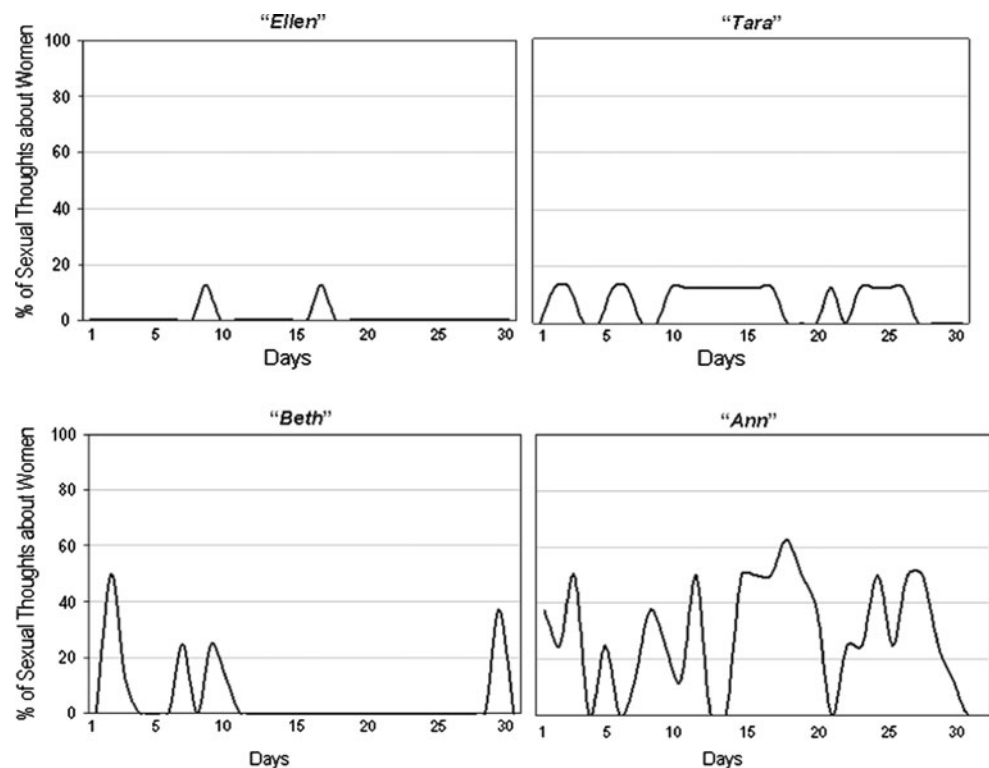
It is also possible that women have multiple, embedded cycles across different spans of time. Consider Jennifer's long-term pattern of change: in any 1-month or 2-month period of time *within* this pattern, she may show additional day-to-day variability. To provide an example of how much interindividual variability we might expect to see from woman to woman, consider the four waveforms in Fig. 2. These are data collected from four participants in an ongoing study in which women provided daily ratings of their same-sex and other-sex attractions, fantasies, behavior, etc., over a 30-day period. These graphs represent the percentage of each woman's sexual thoughts that focused on women versus men during the course of the day. Each of these women self-identifies as heterosexual, and yet there is clearly substantial variation from woman to woman in

the degree and frequency of her sexual thoughts about women. "Ellen" reported sexual thoughts about women on only 2 days and only to a small degree. "Tara" is similar to Ellen in that the percentage of her same-sex sexual thoughts was generally low, but she reported a larger total number of days on which she experienced such thoughts. "Beth," like Ellen, reported same-sex thoughts on relatively few days, but the percentage of her sexual thoughts was relatively higher than Ellen and Tara (on day 2, for example, half of her sexual thoughts were about women). Ann showed a pattern that was notably different from the other three, and seems more characteristic of a bisexual woman. She reported a high day-to-day frequency of same-sex sexual thoughts and, on any given day, the percentage of her same-sex sexual thoughts was relatively high. As with the waveforms represented in Fig. 1, computing each woman's 30-day average of "percentage of same-sex sexual thoughts" would capture some of this variation, but clearly not all of it. The fact that each of these women has a heterosexual "compass" tells us little about their distinctive patterns of variation in sexual phenomenology over time.

Implications and Future Directions

At this juncture, an entirely reasonable question is "*Does it matter?*" Certainly, we may gravitate toward increasingly complex assessments of women's sexual desire, measured across both short and long stretches of time, in an attempt to better

Fig. 2 Patterns of variability in four heterosexually-identified women's self-reported percentage of same-sex sexual thoughts over a 30-day period



characterize the underlying dynamics of their sexuality. Yet, is there a substantial gain to be had from this approach, or are we simply measuring complexity for complexity's sake? I provide two illustrative examples of the new information to be had from this approach. First, there is some evidence that the determinants of day-to-day changes in sexual desire may vary for women with different sexual orientations. In a subset of participants from my aforementioned longitudinal study, we measured day-to-day variability in same-sex and other-sex sexual motivation over a span of 10 days, during which women also provided saliva samples for the assessment of their estrogen levels (Diamond & Wallen, 2011). We found that during women's peak estrogen levels (around which time ovulation is most likely to occur), women who had consistently identified as lesbian throughout the study reported a significant increase in their same-sex sexual motivation. This increase was significantly larger than that observed among women who had consistently identified as bisexual throughout the study, and larger than that observed among women who had given up their lesbian or bisexual identities for unlabeled or heterosexual identities during the study. Hence, the findings suggest that not only might lesbian, bisexual, and heterosexual women show different patterns of variation in sexual attraction over time, but the mix of biological and social factors driving these changes may be different.

Another example concerns the four women represented in Fig. 1. As it happens, each of these women showed a remarkably different pattern of identity change over time, which is intriguing to consider in light of each woman's distinct cycle of attractions. Amy identified as lesbian at each and every wave of data collection, and Kelly identified as bisexual during each and every wave of data collection. Yet, both Jennifer and Susan reported periodic changes in their identity labels: Jennifer started out identifying as lesbian, then switched to a bisexual label by the fifth year of the study, and to an "unlabeled" identity by the tenth year. Susan started out "unlabeled," then adopted a lesbian label for approximately 5 years, after which she switched to a bisexual label. Hence, changes in identity may represent women's attempts to represent and reconcile their own distinct patterns of fluctuation in sexual desire over time (Diamond, 2008). Equally important, the identity that a woman adopts may shape her subsequent awareness of same-sex and other-sex desires and her participation in same-sex and other-sex relationships: Given the responsive and context-sensitive nature of female sexual desire (as elucidated by Basson's model), this should influence the amplitude and frequency of her overall waveform.

It remains to be seen whether female sexual orientation is, in fact, more similar to a wave than a compass. My aim is not to posit dynamical systems theory as a tidy solution to our longstanding difficulties modeling female sexual orientation, but instead to highlight the value of dynamical systems as an investigative approach. This approach begins with a fundamentally different, and I would argue, more appropriate, set of premises about the nature, prevalence, and meaning of within-person vari-

ability than do traditional models of same-sex sexuality. Specifically, it places processes of change at the center of our analyses, rather than the periphery. Because dynamical systems models seek to understand the multiple processes responsible for stability and change over time, they appear better suited to representing the responsive, reflexive, and context-sensitive nature of female sexuality. The end result might be more accurate models of female sexual orientation and female sexual phenomenology more generally.

Acknowledgment A version of this article was presented at the University of Lethbridge Workshop, The Puzzle of Sexual Orientation: What Is It and How Does It Work?, Lethbridge, Alberta, Canada, June 2010.

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