

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

---

Faculty Publications, Department of Child, Youth,  
and Family Studies

Child, Youth, and Family Studies, Department of

---

2019

# Sociosexuality, testosterone, and life history status: Prospective associations and longitudinal changes among men in Cebu, Philippines

Lee T. Gettler

*University of Notre Dame*, [lgettler@nd.edu](mailto:lgettler@nd.edu)

Patty X. Kuo

*University of Nebraska-Lincoln*, [pkuo2@unl.edu](mailto:pkuo2@unl.edu)

Stacy Rosenbaum

*Northwestern University*, [stacy.rosenbaum@northwestern.edu](mailto:stacy.rosenbaum@northwestern.edu)

Josephine L. Avila

*University of San Carlos*, [jlavila@usc.edu.ph](mailto:jlavila@usc.edu.ph)

Thomas W. McDade

*Northwestern University*, [t-mcdade@northwestern.edu](mailto:t-mcdade@northwestern.edu)

*See next page for additional authors*

Follow this and additional works at: <https://digitalcommons.unl.edu/famconfacpub>

 Part of the [Developmental Psychology Commons](#), [Family, Life Course, and Society Commons](#), [Other Psychology Commons](#), and the [Other Sociology Commons](#)

---

Gettler, Lee T.; Kuo, Patty X.; Rosenbaum, Stacy; Avila, Josephine L.; McDade, Thomas W.; and Kuzawa, Christopher W., "Sociosexuality, testosterone, and life history status: Prospective associations and longitudinal changes among men in Cebu, Philippines" (2019). *Faculty Publications, Department of Child, Youth, and Family Studies*. 267.  
<https://digitalcommons.unl.edu/famconfacpub/267>

This Article is brought to you for free and open access by the Child, Youth, and Family Studies, Department of at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Faculty Publications, Department of Child, Youth, and Family Studies by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

---

**Authors**

Lee T. Gettler, Patty X. Kuo, Stacy Rosenbaum, Josephine L. Avila, Thomas W. McDade, and Christopher W. Kuzawa

# Sociosexuality, testosterone, and life history status: Prospective associations and longitudinal changes among men in Cebu, Philippines

Lee T. Gettler,<sup>1,2,3</sup> Patty X. Kuo,<sup>1,3</sup> Stacy Rosenbaum,<sup>4,5</sup>  
Josephine L. Avila,<sup>6</sup> Thomas W. McDade,<sup>4</sup> and  
Christopher W. Kuzawa<sup>4</sup>

1 Department of Anthropology, University of Notre Dame,  
Notre Dame, IN 46556, United States

2 The Eck Institute for Global Health, University of Notre Dame,  
Notre Dame, IN 46556, United States

3 William J. Shaw Center for Children and Families, University of  
Notre Dame, South Bend, IN 46635, United States

4 Department of Anthropology, Northwestern University,  
Evanston, IL 60208, United States

5 Davee Center for Epidemiology and Endocrinology,  
Lincoln Park Zoo, Chicago, IL, United States

6 USC-Office of Population Studies Foundation and the Architecture  
Department, University of San Carlos, Metro Cebu, Philippines

*Corresponding author* — L. T. Gettler, Department of Anthropology,  
University of Notre Dame, 244 Corbett Hall, Notre Dame, IN 46556,  
United States; *email* lgettler@nd.edu

## Abstract

Sociosexuality is defined as an individual's interest in uncommitted sexual activity and can be measured in terms of both psychological orientations and behavioral expression. In socio-ecological contexts in which adults monogamously partner and

---

Published in *Evolution and Human Behavior* 40 (2019), pp 249–258.

doi 10.1016/j.evolhumbehav.2018.11.001

Copyright © 2018 Elsevier Inc. Used by permission.

Submitted 28 March 2018; revised 18 August 2018; accepted 5 November 2018.

cooperate to raise children, individuals with unrestricted sociosexuality are likely to prioritize mating/competition over committed partnering and parenting. Given the importance of mother-father cooperation in the evolutionary past, humans may have the capacity to facultatively and opportunistically downregulate sociosexuality to focus on priorities related to invested partnering and parenting. To date, no prior studies have used longitudinal data to track within-individuals changes in sociosexuality as it relates to such life history transitions. Given the lack of prior longitudinal research in this area, it is likewise unknown what physiological mechanisms might mediate within-individual changes in sociosexuality through time but testosterone is a plausible candidate. To explore these questions, we drew on a large, long-running study of Filipino men ( $n=288$ ), who were single non-fathers at 25.9 years of age and were followed up 4–5 years later. We found that men with more unrestricted sociosexuality at baseline were more likely to experience relationship dissolution by follow-up, consistent with past work. Compared to men who remained single non-fathers at follow-up, men who became married residential fathers showed shifts towards more restricted global sociosexuality as well as sociosexual behavior. Relative to their own baseline values, married residential fathers also had more restricted sociosexuality in all domains at follow-up. They were the only group for whom this was found. We found theoretically-consistent but modest support for positive correlations between men's testosterone and their sociosexuality, but no evidence that the two change in tandem together through time. Our results suggest that some amount of between-individual differences in sociosexuality are not stable and can facultatively shift alongside other aspects of male reproductive effort.

**Keywords:** Sociosexual orientation inventory, Mating effort, Fatherhood, Marriage, Pairbonds

## 1. Introduction

Sociosexuality is often broadly defined as women and men's inclinations towards uncommitted sexual opportunities. Overall or "global" sociosexuality as well as its behavioral, cognitive (attitudes), and motivational (desire) dimensions may represent factors that help shape individual variation in life history strategies (Olderbak & Figueredo, 2010; Penke & Asendorpf, 2008; Simpson & Gangestad, 1991). For example, individuals expressing more unrestricted sociosexuality may be oriented towards a faster life history characterized by greater investment in competition and mating effort. Because those tendencies may be incongruent with long-term, monogamous relationships, individuals with more unrestricted sociosexuality might be less interested in or successful at maintaining such partnerships, compared to their peers with restricted sociosexuality (Olderbak & Figueredo, 2010;

Penke & Asendorpf, 2008; Simpson & Gangestad, 1991; Simpson, Wilson, & Winterheld, 2004). Similarly, parents with unrestricted sociosexuality might be less inclined to invest in costly, time-intensive forms of parenting and more likely to prioritize quantity rather than quality of offspring. Sociosexuality might thus be relevant to life history-related trade-offs that occur between investments in mating/competition versus parenting effort or commitment to a single partner.

Some prior research and theory suggests that differences in sociosexuality between individuals are at least partially stable and reflect underlying genetic variation (Bailey, Kirk, Zhu, Dunne, & Martin, 2000; Gangestad & Simpson, 1990; Włodarski & Dunbar, 2015). Moreover, sociosexuality tends to covary with other stable, trait-like characteristics, such as dimensions of personality (Penke & Asendorpf, 2008; Reise & Wright, 1996; Simpson et al., 2004; Simpson & Gangestad, 1991). Yet, a number of lines of evidence also point to the potential flexibility and environmental contingency of sociosexual behaviors, attitudes, and desires. For example, familial developmental environments, ecological dynamics (e.g. adult sex ratios), and broader cultural norms appear to influence individual and population-level differences in attitudes and beliefs about sociosexuality, as well as opportunities to engage in unrestricted sociosexual behavior (Havlicek, Husarova, Rezacova, & Klapilova, 2011; Penke & Asendorpf, 2008; Schaller & Murray, 2008; Schmitt, 2005; Simpson et al., 2004; Sprecher, Treger, & Sakaluk, 2013). Collectively, this work has underscored that longer-term environmental influences and experience contribute to relatively stable, trait-like components of sociosexuality variation. What is presently less clear is whether an individual's sociosexuality might also exhibit a plastic, facultative component that allows tailoring of behavioral priorities in response to or as part of shifts in life history or reproductive strategy. Such within-individual plasticity would align with other studies of human life history strategies, which indicate that their behavioral components and physiological underpinnings can facultatively vary, accommodating the demands of diverse socio-ecological contexts and life stages (Bribiescas, Ellison, & Gray, 2012; Del Giudice, Ellis, & Shirtcliff, 2011; Gettler, 2014; Gray, McHale, & Carre, 2017; Jasienska, 2013; Kuzawa & Bragg, 2012).

In that vein, life history transitions to committed partnering and parenting represent key periods around which transient shifts in sociosexual psychology and behavior may occur. Because mother-father

cooperation in raising multiple highly-dependent young was likely important during our evolutionary history, humans may have the capacity to facultatively and opportunistically shift towards more restricted sociosexuality to focus on those priorities (Bribiescas et al., 2012; Geary, 2000; Gettler, 2014, 2016; Gray & Anderson, 2010). To date, studies of sociosexuality and romantic partnering have generally been limited to cross-sectional designs. By their nature, such studies are not able to tease apart if or how sociosexuality changes through time, and studies comparing sociosexuality between individuals with different partnering statuses have been mixed (Farrelly, Owens, Elliott, Walden, & Wetherell, 2015; van Anders, Hamilton, & Watson, 2007; Zheng, Zhou, Wang, & Hesketh, 2014). However, observations from this work are consistent with the notion that unrestricted sociosexuality may be relatively incompatible with longer-term, monogamous partnering. For example, partnered individuals with more unrestricted sociosexuality scores report lower relationship satisfaction, commitment, and investment (Penke & Asendorpf, 2008; Rodrigues, Lopes, & Pereira, 2017; Simpson & Gangestad, 1991), and partnered men and women with unrestricted sociosexual desire were more likely to separate over the course of a one-year follow up (Penke & Asendorpf, 2008).

Relatively little is known about the ways in which sociosexuality may vary based upon men's parenting status or their roles within families. A study of a large birth cohort in Jamaica showed that men who reported poorer relationship quality with their infant's mother prior to the pregnancy had more sexual partners in the year preceding the survey and more interest in casual sex (i.e. components of sociosexual behavior) following the birth (Gray et al., 2015). These findings suggest that fathers' interest in and pursuit of extra-pair sexual opportunities may vary based upon the quality of their relationship with their spouse or partner. *Within* committed romantic partnerships, couples with better quality relationships have more frequent intercourse (Costa & Brody, 2007; Gray et al., 2017) and are less likely to separate (Yabiku & Gager, 2009), although those dynamics have not been widely studied cross-culturally. Subsequent research by Gray, Reece, et al. (2017) among the previously mentioned Jamaican cohort did not find that fathers' sociosexuality significantly varied based upon the amount of

direct care they provided for their 1–2 year olds (Gray, Reece, et al., 2017). Meanwhile, in recent U.S. research, it was shown that the extent to which parents share caregiving and household duties may affect intimacy frequency (Carlson, Miller, Sassler, & Hanson, 2016). These studies lay an important foundation for considering commonalities and differences in relationships between sociosexuality, fatherhood, and family function in other cultural contexts.

If changes in men's sociosexuality occur as men transition to marriage and invested fatherhood, testosterone (T) is one plausible physiological mediator of those shifts (Roney & Gettler, 2015). Longitudinal studies have shown that men's T declines when they transition to long-term committed relationships and fatherhood (Edelstein et al., 2015; Gettler, McDade, Feranil, & Kuzawa, 2011; Holmboe et al., 2017; Mazur & Michalek, 1998; Saxbe et al., 2017). In multiple cultural contexts, fathers with lower T tend to engage in more direct childcare, and partnered men and women also report lower relationship satisfaction and commitment when they have elevated T (Alvergne, Faurie, & Raymond, 2009; Edelstein et al., 2017; Edelstein, van Anders, Chopik, Goldey, & Wardecker, 2014; Gettler et al., 2011; Gettler, McDade, Bragg, Feranil, & Kuzawa, 2015; Lawson et al., 2017; Mascaro, Hackett, & Rilling, 2013; Muller, Marlowe, Bugumba, & Ellison, 2009). These psychobiological patterns are consistent with T's role in mediating life history trade-offs related to mating/competition and investments in nurturing partnering and parenting (van Anders, 2013). Contextualized in this framework and based on past research, T may also be a mechanism that explains potential changes in sociosexual psychology and behavior, or feedback between the two during life history transitions (Puts et al., 2015). While longitudinal data are lacking, evidence supporting this model is mixed. Some research has found that men with elevated T report more unrestricted sociosexuality (Edelstein, Chopik, & Kean, 2011; Puts et al., 2015), particularly among partnered males (Edelstein et al., 2011; McIntyre et al., 2006). Other studies have found no such relationships (e.g. Farrelly et al., 2015; van Anders et al., 2007). Nothing is currently known about if, and how, within-individual variation in T is related to state-like changes in sociosexuality.

Here, we seek to explore the potential for shorter-term, facultative adjustments in human male sociosexuality and the potential role of T

in those shifts. We draw on data from a large study of males in Metropolitan Cebu, the Philippines to test a series of questions that explore the longitudinal relationships among sociosexuality, life history status, and testosterone. We use data collected at two time points, 4–5 years apart, when men were an average of 25.9 (baseline) and 30.5 (follow-up) years old. We focus our core analyses on men who were single non-fathers at baseline ( $n=288$ ) in order to test for longitudinal, prospective associations between sociosexuality and life history status and to isolate the effects of life history transitions on sociosexuality. We specifically test whether single non-fathers with more unrestricted sociosexuality at baseline were more likely to exhibit patterns consistent with a faster life history strategy by: a) remaining single; b) becoming nonresidential fathers by follow-up; or c) experiencing relationship dissolution over the study period. We then test whether men who became married residential fathers or married non-fathers by follow-up exhibited longitudinal declines in their sociosexuality scores compared to men who remained single non-fathers over the study period. In these models, we test whether change in T over the study period helps explain links between life history transitions and sociosexuality. Finally, as a complement to these longitudinal models, we use data on relationship quality and within-couple sexuality from men who became newly married by follow-up ( $n=99$ ) to shed light on potential trade-offs between men's sociosexuality and relationship function in this setting.

## 2. Materials and methods

### 2.1. Study population

Data were collected in 2009 (baseline) and 2014 (follow-up) as part of the Cebu Longitudinal Health and Nutrition Survey (CLHNS), a population-based birth cohort of infants born in 1983–1984 in the Metro Cebu region of the Philippines (Adair et al., 2011). Men were an average of 25.9 ( $\pm 0.3$ , SD) and 30.5 ( $\pm 0.3$ ) years of age at the time of data and sample collection at baseline and follow-up, respectively. We report descriptive statistics for the sample in **Table 1**.



**Table 1.** Descriptive statistics (n=288).

<i>Demographic characteristics (follow-up)</i>	<i>Mean</i>	<i>SD</i>
Age (years)	30.49	0.31
Education (highest grade)	11.16	3.49
Single non-fathers (% y)	56.6%	–
Married residential fathers (% y)	29.2%	–
Married non-fathers (% y)	9.4%	–
Single non-residential father (% y)	4.9%	–
Baseline sociosexuality		
Global sociosexuality	24.19	9.43
Sociosexual behavior	6.36	3.58
Sociosexual desire	6.19	3.23
<i>Sociosexual</i> attitude	11.64	5.65
Follow-up sociosexuality		
Global sociosexuality	21.83	9.30
Sociosexual behavior	5.91	3.60
Sociosexual desire	5.83	3.57
Sociosexual attitude	10.09	5.61
Follow-up marital relationship dynamics		
RDAS total score <sup>a</sup>	49.47	8.75
Sexual intercourse frequency with partner (past year) <sup>b</sup>	78.61	52.85
Baseline testosterone (T)		
AMT (pg/ml)	169.89	66.54
PM T (pg/ml)	102.81	43.35
Follow-up T		
AMT (pg/ml)	118.63	44.31
PM T (pg/ml)	69.62	25.00

a. marital relationship quality from the Revised Dyadic Adjustment Scale (RDAS; see Methods); n=99.

b. men were asked to estimate the number of times they had sexual intercourse with their partner in the past year; n=99.

## 2.2. Sociodemographics

Socioeconomic, demographic, and behavioral data were collected during in-home interviews administered by Cebuano-speaking interviewers (Adair et al., 2011). In the present analysis men are defined as “married” if they identified themselves as being legally married or cohabitating (Gettler et al., 2011; Kuzawa, Gettler, Muller, McDade, & Feranil, 2009). Single men at baseline are those who were unmarried or not cohabitating. Fathers are defined as men who reported having one or more biological children and a father’s residence status was

characterized by whether he resided with at least one of his biological children or none of them (Gettler et al., 2011; Gettler, McDade, Agustin, Feranil, & Kuzawa, 2015). Divorce is illegal in the Philippines, whereas marital separations and annulments are possible and do occur. We classified men as having experienced “separation” or relationship instability during the 4–5 year follow-up period if they were married multiple times during that specific time period or reported being separated at the follow-up interview (Gettler et al., 2017). Our core longitudinal analyses below focus on men who were single non-fathers at baseline and who either remained single non-fathers by follow-up ( $n=163$ ) or transitioned to these life history status categories by follow-up: married non-fathers ( $n=27$ ); single non-residential fathers ( $n=14$ ); married residential fathers ( $n=84$ ). There were a small number of otherwise eligible men who transitioned to other combinations of marital and fatherhood (residential vs. non-residential) statuses but those cell sizes were too small to be included in the analyses (e.g.  $n$ 's < 10).

### 2.3. *Sociosexuality*

Men filled out the revised version of the Sociosexuality Orientation Inventory (SOI-R), which can be found in (Penke & Asendorpf, 2008). The SOI-R includes nine items, each of which are scored on a scale from 1 to 9. These nine items can be summed to form a measure of overall (or “global”) sociosexuality. They can also be broken into three sub-scales that measure psychometrically distinct components: sociosexual behavior, desire, and attitudes (Penke & Asendorpf, 2008). The behavioral sub-scale captures information regarding past uncommitted sexual activity. The desire sub-scale measures interest and motivation for uncommitted sexual opportunities, and the attitude sub-scale assesses individuals' beliefs about sociosexuality (Penke & Asendorpf, 2008). At baseline, the reliability scores (Cronbach's  $\alpha$ ) for the global sociosexuality summary scale as well as the sociosexual behavior and desire sub-scales ranged from  $\alpha=0.72$ – $0.82$ . The reliability score for the attitude sub-scale was  $\alpha=0.51$ . At follow up, the reliability scores for the scales were as follows: global sociosexuality ( $\alpha=0.69$ ), behavior ( $\alpha=0.81$ ), desire ( $\alpha=0.85$ ), and attitude ( $\alpha=0.45$ ).

#### *2.4. Marital relationship quality and within-couple sexual dynamics*

Married men filled out the Revised Dyadic Adjustment Scale (RDAS). The RDAS has 14 items, each of which is scored on a scale of 0 to 5, and the scale has a focus on relationship quality in three domains: Consensus, Satisfaction, and Cohesion (Busby, Christensen, Crane, & Larson, 1995). The Satisfaction sub-scale includes two components for relationship (1) conflict and (2) stability. We include these components in our analyses, given that unrestricted sociosexuality and relationship conflict and stability may potentially interrelate in a setting such as Cebu. At this site, long-term, monogamous partnerships are culturally valued, but it is not uncommon for men, particularly, to engage in extra-marital affairs (Gonzales, Greer, Scheers, Oakes, & Buckley, 2004). Items in the conflict and stability components focus on the frequency of events within the dyad (e.g. conflict: quarreling between partners; stability: discussion or consideration of relationship separation). These items are scored on temporal scales regarding the frequency of the events, such as "all the time" (0) to "never" (5). Other items within the RDAS focus on consensus between partners on topics such as demonstrations of affection or sexual relations, with scores that range from "always disagree" (0) to "always agree" (5). The reliability scores (Cronbach's  $\alpha$ ) were as follows: overall RDAS ( $\alpha=0.77$ ), conflict ( $\alpha=0.77$ ), and stability ( $\alpha=0.45$ ). Finally, separate from the RDAS, married men also estimated the number of times they had intercourse with their partner in the past year, which we include for descriptive purposes, given the focus of the current study on sexuality. The majority of the married men ( $n=99/111$ ) in the current study had full data on these measures.

#### *2.5. Salivary T collection and measurement*

Similar saliva collection procedures were used at baseline and follow-up, with the exception that the follow-up survey included repeated sampling for each subject (four total samples). Each participant was provided with instructions and polypropylene tubes for saliva collection. They collected the first sample immediately before bed (PM), and they were instructed to collect the second sample immediately on waking the following morning (AM). At follow-up, this same procedure was followed for a second collection period, which occurred

an average of 7.1  $\pm$  5.8 (SD) days later. Men reported the time of saliva collection for each sample. Mean AM sampling times were 6:58 AM  $\pm$  1:58 at baseline and 7:03 AM  $\pm$  2:05 at follow-up. Mean PM sampling times were 10:26  $\pm$  2:29 at baseline and 10:25  $\pm$  2:35 at follow-up. For each 24-h collection period, saliva tubes were retrieved on the second day by an interviewer and stored at  $-35^{\circ}\text{C}$  until they were shipped frozen to Northwestern University or the University of Notre Dame, where they were stored at  $-80^{\circ}\text{C}$ .

## 2.6. Salivary T assessment

T concentrations were determined at the Laboratory for Human Biology Research at Northwestern University using an enzyme immunoassay protocol developed for use with saliva samples (Salimetrics, Carlsbad, CA; Kit No. 1-2402). Interassay coefficients of variation were 7.8% and 17.9% for high and low kit-based control samples, in the baseline analyses, and 6.3% and 12.2%, respectively, for the follow-up analyses.

## 2.7. Statistical analysis

We conducted statistical analyses using Stata 14.0 (Stata Corporation). We created average AM T and PM T variables for the follow-up data by taking the mean of the two AM and PM values, respectively. T values were statistically adjusted for their sampling times (baseline and follow-up). These adjustments were conducted by regressing the T value on the time of sample collection. For each model, we then predicted the residuals and added the original dependent variable's mean to the residuals, which removes the effect of the independent variable on the dependent variable (Gettler, McKenna, Agustin, McDade, & Kuzawa, 2012). We used these adjusted T values to calculate absolute change in T between baseline and follow-up. We also calculated within-individual change in sociosexuality by subtracting men's baseline values from their scores at follow-up.

We first report bivariate associations between men's sociosexuality measures and T at baseline and follow-up, respectively, and the men's change scores (between baseline and follow-up) using Pearson's correlation coefficients ( $r$ ). Using logistic regression, we then tested whether men's baseline sociosexuality predicted aspects of their life

history status at follow-up. Next, we used OLS regression to predict men's changes in sociosexuality based on life history transitions between baseline and follow-up, using men who remained single non-fathers as the comparison group. We included men's changes in T over the study period as a potential explanatory variable in those models. In a similar OLS regression model, we also tested for differences in men's sociosexuality at follow-up based on life history status. We tested for within-group differences between baseline and follow-up sociosexuality using repeated measures (RM) ANOVA, grouping men according to their life history status at follow-up. Finally, for married men at follow-up, we used Pearson's correlation coefficients ( $r$ ) to test for associations between marital relationship dynamics and sociosexuality. We evaluated statistical significance at  $p < 0.05$ .

### 3. Results

In this sample of men who were single non-fathers at baseline (2009), ~39% had become married (overall) and 34% had transitioned to fatherhood by follow-up (2014). The majority of those fathers (~86%) resided with at least one of their biological children. Across the entire sample, men's global sociosexuality and sociosexual behavior and attitude scores were significantly lower at follow-up compared to baseline (all  $p < 0.05$ ; see Table 1 and Supp. Materials), while their sociosexual desire was not lower at follow-up compared to baseline ( $p > 0.4$ ; see Table 1 and Supp. Materials).

We then tested for cross-sectional and longitudinal associations between sociosexual scores and T. At baseline, men with more unrestricted global sociosexuality also had more unrestricted scores for sociosexual behavior, desire, and attitude at baseline (all  $p < 0.0001$ ; Table 2a). At follow-up, those four measures were similarly positively correlated with one another (all  $p < 0.0001$ ; Table 2a). Notably, men's sociosexuality was also positively correlated across the two surveys in our longitudinal sample, such that men who had more unrestricted sociosexuality at baseline likewise reported more unrestricted sociosexuality at follow-up in all domains (all  $p < 0.05$ ; Table 2a). Men's changes in sociosexuality scores were also positively correlated with one another across all four domains (all  $p < 0.05$ ; Table 2b).

**Table 2a.** Bivariate correlations ( $r$ ) between sociosexuality scores at baseline and follow-up for single non-fathers at baseline ( $n=288$ )<sup>a</sup>.

Baseline Follow-up T	1	2	3	4	5	6	7	8	9	10	11	12
Baseline												
1. global	1.0											
2. behavior	0.71****	1.0										
3. desire	0.69****	0.41***	1.0									
4. attitude	0.83****	0.31***	0.32***	1.0								
Follow-up												
5. global	0.50****	0.38***	0.45***	0.34***	1.0							
6. behavior	0.44****	0.48***	0.38***	0.22***	0.72***	1.0						
7. desire	0.31****	0.15*	0.48***	0.16**	0.60***	0.29***	1.0					
8. attitude	0.34****	0.24***	0.19***	0.31***	0.81***	0.36***	0.17**	1.0				
Baseline T												
9. AM T	0.06	0.08	-0.02	0.06	0.06	0.09	0.03	0.02	1.0			
10. PM T	0.09	0.03	0.07	0.09	0.02	0.04	-0.02	0.02	0.49****	1.0		
Follow-up T												
11. AM T	0.08	0.09	0.07	0.04	0.08	0.08	0.06	0.04	0.22***	0.06	1.0	
12. PM T	0.13*	0.11	0.10	0.09	0.15*	0.10	0.09	0.13*	0.20**	0.22***	0.55****	1.0

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ ; \*\*\*\*  $p < 0.0001$

a. global: global sociosexuality; behavior: sociosexual behavior scores; desire: sociosexual desire scores; attitude: sociosexual attitude scores.

**Table 2b.** Bivariate correlations ( $r$ ) between sociosexuality change ( $\Delta$ ) scores and T change scores between baseline and follow-up for single non-fathers at baseline ( $n=288$ )<sup>a</sup>.

Change scores	1	2	3	4	5	6
1. $\Delta$ global	1.0					
2. $\Delta$ behavior	0.59****	1.0				
3. $\Delta$ desire	0.52****	0.18**	1.0			
4. $\Delta$ attitude	0.82****	0.18**	0.11	1.0		
5. $\Delta$ AM T	-0.01	-0.01	-0.06	0.03	1.0	
6. $\Delta$ PM T	0.08	-0.02	0.08	0.08	0.49****	1.0

\* $p < 0.05$ ; \*\* $p < 0.001$ ; \*\*\* $p < 0.001$ ; \*\*\*\* $p < 0.0001$ .

a. global: global sociosexuality; behavior: sociosexual behavior scores; desire: sociosexual desire scores; attitude: sociosexual attitude scores.

When evaluating correlations between T and sociosexuality, we did not find significant associations between men's baseline T and sociosexuality (all  $p > 0.1$ ; Table 2a). At follow-up, there were no significant associations between men's follow-up AMT and sociosexuality (all  $p > 0.1$ ), and men's follow-up sociosexual desire was not significantly associated with follow-up PM T ( $p > 0.1$ ). However, men with elevated PM T at follow-up had more unrestricted global sociosexuality ( $p=0.01$ ) and attitude scores ( $p=0.03$ ) and tended to report elevated

**Table 3.** Bivariate logistic regression models predicting men's likelihood of becoming separated by follow-up based on sociosexuality at baseline among single nonfathers<sup>a</sup>.

	OR	SE	p
Baseline sociosexuality scores <sup>b</sup>			
Global	1.03	0.02	0.17
Behavior	1.14	0.05	0.005
Desire	1.01	0.07	0.87
Attitude	1.01	0.04	0.74

a. n = 288.

b. each baseline sociosexuality score predictor was run in a separate model.

sociosexual behavior at the same time point ( $p=0.08$ ; Table 2a). There were no significant bivariate correlations between changes in men's T and changes in their sociosexuality scores between baseline and follow-up (all  $p > 0.1$ ; Table 2b).

### 3.1. Prospective associations between baseline sociosexuality and life history status at follow-up

Single non-fathers with elevated baseline sociosexuality were not more likely to remain single versus get married over the study period (all  $p > 0.3$ ). Similarly, men's baseline sociosexuality was not significantly predictive of whether they became a nonresidential father by follow-up (all  $p > 0.2$ ). Men's baseline global sociosexuality and their sociosexual desire and attitude scores did not predict whether they experienced separation over the course of the follow-up period (all  $p > 0.1$ ). However, single non-fathers reporting more unrestricted sociosexual behavior at baseline were significantly more likely to have experienced separation during the study period compared to men with restricted sociosexual behavior [OR (SE): 1.14 (0.05);  $p=0.005$ ]; Table 3).

### 3.2. Longitudinal changes in sociosexuality based on men's life history status at follow-up

When compared to their peers who remained single and childless across the study period, men who transitioned from being single non-fathers to married residential fathers by follow-up exhibited larger

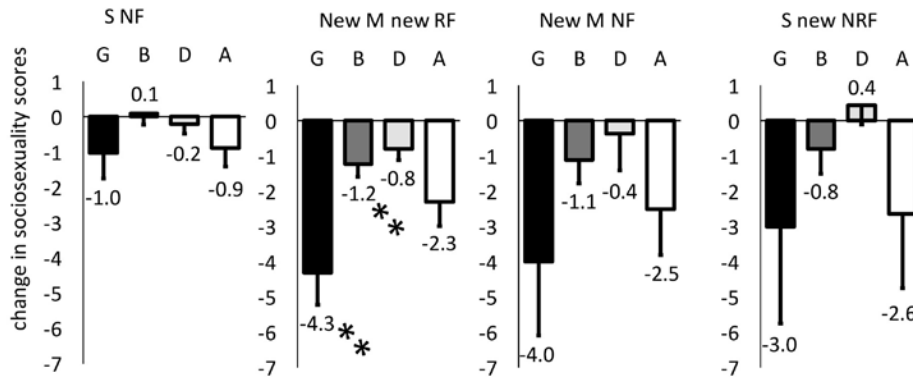
**Table 4.** Predicting longitudinal changes in sociosexuality based on life history status at follow-up among single non-fathers at baseline.<sup>a</sup>

	Change in global sociosexuality						Change in sociosexual behavior					
	Model 1			Model 2			Model 1			Model 2		
	b	SE	p	b	SE	p	b	SE	p	b	SE	p
Men's marital and fatherhood status <sup>b</sup>												
Single non-F to M non-F	-2.98	1.93	0.12	-2.85	1.93	0.14	-1.20	0.76	0.12	-1.21	0.76	0.11
Single non-F to single non-res. F	-1.98	2.59	0.44	-2.26	2.59	0.39	-0.87	1.01	0.39	-0.85	1.02	0.41
Single non-F to M res. F	-3.30	1.25	0.009	-3.29	1.25	0.009	-1.31	0.49	0.008	-1.31	0.49	0.008
Change in PM T				0.02	0.01	0.18				-0.001	0.005	0.76
Model R <sup>2</sup>		0.028			0.034			0.029			0.029	

a. n=288. F=father. Res. = residential. M=married.

b. Comparison group: men who were single non—Fs at baseline and follow up, n=163; sample sizes for other groups: single non-F to M non—F, n=27; single non-F to single non-res. F, n=14; single non-F to M res. F, n=84.

declines in their global sociosexuality and sociosexual behavior scores (both  $p < 0.01$ ; Table 4; Fig. 1). When we added men's longitudinal change in PM T to the models as a potential mediator, the significant results and effect sizes for global sociosexuality and sociosexual behavior were unchanged (Table 4). If we included changes in men's AM T as a covariate, in place of change in PM T, it did not affect the results. Changes in men's PM and AMT did not significantly predict changes in men's sociosexuality (all  $p > 0.1$ ). Men's changes in sociosexual desire and attitude did not significantly differ based on life



G: global sociosexuality; B: sociosexual behavior score; D: sociosexual desire score; A: sociosexual attitude score

S: single; M: married. NF: non-father; RF: residential father; NRF: non-residential father

\*\* $p < 0.01$ ; Error bars indicate SEM. See Table 4 for full model results

**Fig. 1.** Sociosexuality changes between baseline and follow-up among single non-fathers at baseline.



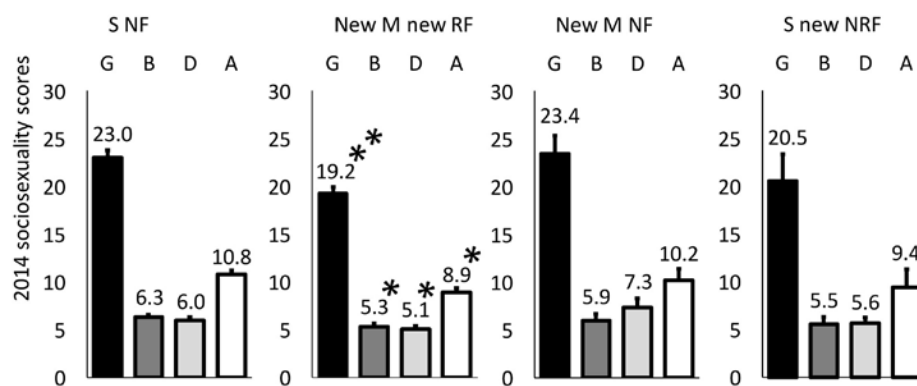
history transitions ( $p > 0.1$ ). Men who transitioned to being married non-fathers or single non-residential fathers, respectively, by follow-up did not differ significantly for changes in sociosexuality, relative to men who remained single non-fathers (all  $p > 0.1$ ).

### 3.3. Comparing men's follow-up sociosexuality to their own scores at baseline, based on life history status at follow-up

We found that men who transitioned from being single non-fathers to being married residential fathers had more restricted sociosexuality scores in all domains at follow-up, compared to their own values in at baseline (all  $p < 0.05$ ). Men who became married non-fathers also had more restricted global sociosexuality and attitude scores compared to their own baseline values ( $p < 0.05$ ). Among men who remained single non-fathers and those who became single non-residential fathers, their follow-up sociosexuality did not differ significantly from their own scores at baseline, although single non-fathers' attitude scores tended to be more restricted ( $p=0.08$ ; all others,  $p > 0.1$ ; Table S1).

### 3.4. Cross-sectional comparisons of men's baseline and follow-up sociosexuality, based on life history status at follow-up

Compared to men who remained single non-fathers across the study period, men who became married residential fathers had more restricted sociosexuality in all domains at follow-up (all  $p \leq 0.05$ ; Fig. 2).



G: global sociosexuality; B: sociosexual behavior score; D: sociosexual desire score; A: sociosexual attitude score

S: single; M: married. NF: non-father; RF: residential father; NRF: non-residential father

\* $p \leq 0.05$ ; \*\* $p < 0.01$ ; Error bars indicate SEM. See Table 5 for full model results

**Fig. 2.** Sociosexuality at follow-up based on life history status at follow-up.

When we included men's follow-up PM T as a covariate in these models, the effect size and significance for global sociosexuality and attitude scores, respectively, changed minimally (both  $p < 0.05$ ), though men with elevated PM T had more unrestricted global sociosexuality and attitude scores in both models ( $p \leq 0.05$ ; Table 5). In the models for sociosexual behavior and desire, the effect sizes decreased modestly and the findings were no longer statistically significant (both  $p > 0.05$ ; Table 5) with the addition of PM T. Men who were married non-fathers at follow-up tended to have more unrestricted sociosexual desire scores relative to the comparison group ( $p = 0.07$ ; Fig. 2; Table 5). Married non-fathers did not otherwise differ from single non-fathers at follow-up (all  $p > 0.6$ ). Men who became single non-residential fathers by follow-up did not significantly differ from the comparison group for any sociosexuality measure at follow-up (all  $p > 0.2$ ; Fig. 2; Table 5).

### 3.5. Cross-sectional associations between sociosexuality and relationship dynamics for married men at follow-up (2014)

Finally, we used data from men who transitioned to marriage by follow-up ( $n = 99$ ) to shed light on associations between men's sociosexuality and marital relationship function and to provide context at this site regarding sociosexuality and within-couple sexual dynamics. In Table 6, we report bivariate correlations for measures in these domains. Married men with more unrestricted global sociosexuality or attitude scores reported lower overall marital relationship quality (both  $p < 0.01$ ).

**Table 5.** Predicting men's follow-up sociosexuality based on life history status at follow-up.<sup>a</sup>

<i>Men's marital and fatherhood status<sup>b</sup></i>	<i>Global sociosexuality</i>			<i>Sociosexual behavior</i>			<i>Sociosexual desire</i>			<i>Sociosexual attitude</i>		
	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>	<i>b</i>	<i>SE</i>	<i>p</i>
M non-F	0.50	1.89	0.79	-0.32	0.74	0.67	1.36	0.73	0.07	-0.54	1.15	0.64
Single non-res. F	-2.93	2.54	0.25	-0.88	1.00	0.38	-0.44	0.99	0.66	-1.62	1.55	0.30
M res. F	-3.42	1.23	0.006	-0.89	0.49	0.07	-0.85	0.48	0.08	-1.68	0.75	0.03
PM T	0.05	0.02	0.02	0.01	0.01	0.12	0.01	0.01	0.19	0.03	0.01	0.05
Model R2		0.054			0.024			0.037			0.036	

a.  $n = 288$ . F=father. Res. = residential. M=married.

b. Comparison group: men who were single non-Fs at follow up,  $n = 163$ ; sample sizes for other groups: M non-F,  $n = 27$ ; single non-res. F,  $n = 14$ ; M res. F,  $n = 84$ .

**Table 6.** Bivariate correlations ( $r$ ) between sociosexuality scores and marital relationship dynamics at follow-up for newly married men ( $n=99$ ).<sup>a</sup>

	1	2	3	4	5	6	7	8
1. global	1.0							
2. behavior	0.63****	1.0						
3. desire	0.60****	0.18	1.0					
4. attitude	0.85****	0.37***	0.20*	1.0				
5. overall relationship quality <sup>b</sup>	-0.28**	-0.16	-0.11	-0.28**	1.0			
6. relationship conflict <sup>b</sup>	-0.39***	-0.25*	-0.25*	-0.31**	0.58****	1.0		
7. relationship stability <sup>c, b</sup>	-0.33***	-0.26**	-0.19	-0.26**	0.57****	0.56***	1.0	
8. marital intercourse frequency <sup>d</sup>	0.16	-0.07	0.21*	0.14	0.05	-0.15	-0.09	1.0

\*  $p < 0.05$ ; \*\*  $p < 0.01$ ; \*\*\*  $p < 0.001$ ; \*\*\*\*  $p < 0.0001$

a. global: global sociosexuality; behavior: sociosexual behavior scores; desire: sociosexual desire scores; attitude: sociosexual attitude scores.

b. marital relationship quality from the revised Dyadic Adjustment Scale (RDAS; see Methods); on the RDAS, higher relationship conflict scores indicate lower conflict.

c. scores from the following item on the RDAS: extent of disagreement/agreement between partners regarding sexual relations.

d. men were asked to estimate the number of times they had sexual intercourse with their partner in the past year.

Men with more unrestricted sociosexuality in all domains reported greater marital conflict (all  $p < 0.05$ ) and lower marital stability (sociosexual desire,  $p=0.06$ ; other domains,  $p < 0.05$ ). Married men with more unrestricted sociosexual desires reported more frequent intercourse with their spouses ( $p < 0.05$ ; Table 6), but within-couple intercourse frequency was not significantly associated with other measures of sociosexuality or relationship quality (all  $p > 0.1$ ).

#### 4. Discussion

Past studies linking sociosexuality to relationship dynamics and psychobiology have tended to be cross-sectional and often treat sociosexuality as a stable, trait-like characteristic (Penke & Asendorpf, 2008; Simpson & Gangestad, 1991). They have typically lacked longitudinal data to assess whether sociosexuality changes as relationship and familial dynamics shift, paralleling (for example) declines in men's T as they transition to marriage and fatherhood in some settings (Gettler, 2014; Gray, McHale, & Carre, 2017). In this large longitudinal study of Filipino males, men's scores for global sociosexuality and sociosexual behavior declined significantly when they transitioned from being single non-fathers to being married residential fathers over the 4–5 year

study period, compared to men who remained single non-fathers. To our knowledge, our results are the first evidence that men's sociosexuality has an element of plasticity in response to life history transitions.

#### *4.1. Patterns of sociosexuality change across first time life history transitions*

From an evolutionary perspective, it would likely have been relatively common for human males and females to partner with one another in serially monogamous relationships and to cooperate to raise highly dependent and slow growing offspring (Bribiescas et al., 2012; Geary, 2000; Gettler, 2010, 2014; Gray & Anderson, 2010). Under those social and ecological circumstances, males whose sociosexuality became more restricted across life history transitions may have more effectively recalibrated their energetic and social/behavioral reproductive priorities towards familial demands and away from mating effort. Cebu is a context in which monogamous partnering and intensive paternal investment are generally valued aspects of the cultural system (Gettler, McDade, Agustin, et al., 2015; Medina, 2001). Traditionally, families played a primary role in arranging and supervising courtship for men and women (Medina, 2001), but for men in the age range of the present study, individuals now have greater ability to guide their own romantic/dating choices and experiences. Earlier CLHNS work showed that >72% of males were dating and had been in a romantic relationship by the time they were 17–19 years old, while only around half of sexually active males (at that time) reported that their first intercourse was with a committed romantic partner (Upadhyay, Hindin, & Gultiano, 2006). By age 26, ~92% of men in the study were sexually active and their average age at first sex was 18.4 years (Gettler, McDade, Bragg, et al., 2015). In the present study, ~93% of single non-fathers lived in households with other family members, which could potentially pose some barriers to their opportunities for sexual activity, compared to living independently. Approximately 61% of single non-fathers reported having a sexual partner in the prior year, with ~23% reporting multiple partners. Meanwhile, ~36% reported being in a non-cohabitating romantic relationship at the time of interview. In total, these dynamics are likely to influence single non-fathers' sociosexuality (particularly global and behavior scores) towards more restricted scores

than might be found among single non-fathers in some other settings (e.g. certain populations in Europe and the U.S.; Penke & Asendorpf, 2008; Puts et al., 2015). This might lead to greater than expected similarities with men with other life history statuses, such as with married fathers in Cebu.

Thus, against this backdrop, it is notable that men who were single non-fathers and became married residential fathers by follow-up showed significantly larger declines in their global and behavior sociosexuality scores compared to men who remained single non-fathers across the study period. Married residential fathers' sociosexuality at follow-up was also significantly more restricted in all areas, compared to their own values at baseline. They were the only group for whom this was observed. Moreover, at follow-up, married residential fathers also had more restricted sociosexuality in all domains compared to single non-fathers.

In total, among men becoming married residential fathers, we see evidence for sociosexuality becoming more restricted as they experience that life history transition. In particular, across all of our analyses comparing values through time and between groups, married residential fathers exhibited shifts towards more restricted sociosexual behavior, which (compared to desire or attitude, as psychological orientations) may impose the steepest trade-offs to invested fathering. In showing that sociosexuality is a flexible component of male life history strategies, these results are thus complementary to existing evolutionary-grounded research on the facultative nature of male reproductive strategies and psychobiology (Bribiescas et al., 2012; Gettler, 2014, 2016; Kuzawa & Bragg, 2012).

In contrast to our results for married residential fathers, we observed limited evidence that men transitioning to marriage alone (in the absence of fatherhood) exhibited declining sociosexuality scores across the study period. Their follow-up global and attitude sociosexuality scores were more restricted compared to their own values at baseline. However, their change scores and follow-up levels of sociosexuality did not significantly differ from men who remained single non-fathers at follow-up. The general similarities in sociosexuality between married non-fathers and single non-fathers (i.e. for change scores and in cross-section at follow-up) are consistent with some prior studies elsewhere that have not found differences between single and partnered men (Farrelly et al., 2015; Penke & Asendorpf, 2008).

Overall, past research has found mixed evidence for sociosexuality differences between people who are single versus those in various types of romantic relationships. Some of the heterogeneity across studies might be attributable to differences in study setting (i.e. cultural/ecological factors), sample demographics and size, or variations in partnering categories (one partner vs. polyamorous) (Edelstein et al., 2011; Farrelly et al., 2015; Gray, McHale, & Carre, 2017; Penke & Asendorpf, 2008; van Anders et al., 2007; Zheng et al., 2014). Yet, an additional contributing factor could be that most of these prior studies did not report or analyze participants' parenting status. Some of this past work has focused on populations who were unlikely to be parents or had a very low preponderance of parents (i.e. U.S. or European undergraduate students) thus making it unlikely that the inclusion of such data would have added further insights (Edelstein et al., 2011; Farrelly et al., 2015). However, studies in other cultural contexts and with more diverse demographics (e.g. a wider age range or older demographics, compared to studies of undergraduate students) may have benefitted from considering parenting status alongside romantic relationship status and dynamics (Penke & Asendorpf, 2008; Zheng et al., 2014).

Our study helps shed light on the under-studied role that the dual experience of partnering and residential fatherhood might play in shaping men's sociosexuality in cultural contexts that share family system similarities with Cebu. Meanwhile, in a recent, large study of Jamaican men, Gray, Reece, et al. (2017) did not find significant variation between fathers for sociosexuality based on whether the men were single, married, or in other types of partnerships. While their study did not include contrasts between fathers and non-fathers, preventing direct comparisons to our key results here, these cross-study differences are consistent with the notion that variation in sociosexuality based on parenting/partnering status and forms of parenting effort will differ based on cultural and ecological factors. These are important considerations for future research focused on individuals in their reproductive primes and beyond, particularly for studies aiming to model the intersections between life history strategies and individual characteristics related to dimensions of sexuality and mating effort.

Alongside these results that indicate malleability of men's sociosexuality across first-time life history transitions, we also found that single non-fathers who reported more unrestricted sociosexual behavior

at baseline were more likely to have experienced relationship dissolution over the study period. One of the few prior longitudinal studies in this domain also showed that partnered men and women with elevated sociosexual behavior scores were more likely to have separated from their partner over the course of a one year follow-up (Penke & Asendorpf, 2008). The measurement of sociosexual behavior in the SOIR involves questions regarding relatively recent (past 12 months) and lifetime casual or uncommitted sexual experiences. Consistent with Penke and Asendorpf's (2008) interpretation, our results suggest that there is some component of men's orientation towards sociosexual behavior that is trait-like and potentially stably predicts if they will continue to pursue extra-pair mating effort even after partnering. Infidelity would be a probable contributor to the likelihood of separation in Cebu and other parts of the Philippines (Gonzales et al., 2004). Our correlative analyses for married men at follow-up also generally complement these results and past work (Gonzales et al., 2004; Gray et al., 2015; Penke & Asendorpf, 2008; Rodrigues et al., 2017; Simpson & Gangestad, 1991), indicating that marital relationship conflict is higher and stability is lower when men have more unrestricted sociosexuality. Collectively, these findings help substantiate the idea that relationship function and quality could benefit when males' sociosexuality becomes more restricted across life history transitions in contexts like Cebu.

#### *4.2. Testosterone and sociosexuality in Cebu*

Our past work at this site has documented changes in men's T across the transition to marriage and fatherhood along with interrelationships between men's T, relationship outcomes, paternal care, and sexual behavior with their partners (Gettler et al., 2011, 2012; Gettler et al., 2017; Gettler, McDade, Agustin, et al., 2015; Gettler, McDade, Agustin, Feranil, & Kuzawa, 2013; Kuzawa et al., 2009). Based on these past findings, we predicted that T would be a physiological mechanism through which changes in sociosexuality based on life history status would be mediated in this setting. We found mixed evidence for this hypothesis. Men's changes in sociosexuality were not significantly related to their T changes across the study period, nor did changes in T help explain the differences for sociosexuality change scores between men transitioning from being single non-fathers to married residential

fathers versus those who remained single non-fathers throughout. Thus, it is possible that as men first transition to committed fatherhood in Cebu they exhibit large average declines in T and shifts towards more restricted sociosexuality as complementary but separate aspects of changing reproductive effort and priorities (Gettler et al., 2011; Gettler et al., 2013; Gettler, McDade, Agustin, et al., 2015). We also note that our past findings for changes in T across first-time life history transitions (e.g. Gettler et al., 2011) were for men between 21.5 and 26 years of age and the present findings for shifts in sociosexuality are for men between ages 26–30.5 years. Thus, they represent two different age cohorts of men within the Cebu study and there could be selection issues that pertain to these patterns (e.g. for changes in T), which we plan to explore in future work (Kuzawa, McDade, Rosenbaum, Borja, & Gettler, 2018).

Moreover, at follow-up, men with higher evening T had more unrestricted global sociosexuality and attitude scores, but evening T did not meaningfully attenuate the relationship between global sociosexuality or attitude scores and life history status, respectively. In contrast, when we included PM T in the models predicting men's follow-up sociosexual behavior and desire, the differences between single nonfathers and married residential fathers became non-significant and the effect sizes diminished modestly. Those patterns suggest that variation in men's T did help explain at least a minor component of the differences in sociosexuality based on life history status at follow-up. These findings show some commonalities with past psychobiological studies using the SOI-R and its sub-scales. For example, existing studies have found significant positive correlations between men's T and their global sociosexuality, desire, and attitude ( $r$ 's: 0.16 to 0.33) but not for sociosexual behavior ( $r$ 's:  $-0.01$  to 0.06) (Edelstein et al., 2011; Puts et al., 2015; cf. Farrelly et al., 2015). In total, while our findings for T are modest, they are consistent with existing models that predict linkages between competitive orientations to mating effort and men's psychobiology (Gray, McHale, & Carre, 2017; Puts et al., 2015; Roney & Gettler, 2015; van Anders, 2013).

#### 4.3. *Limitations*

Our study has limitations that warrant further mention. Our baseline salivary T measures were based on single sampling from each subject



at waking and bedtime, which can contribute to reduced reliability and Type II errors. We did not find robust linkages between men's baseline T or changes in T and sociosexuality yet we did collect multiple waking and evening samples per individual at follow-up and found some positive correlations between evening T and sociosexuality at that time point. Such associations are consistent with existing psychobiological and evolutionary models as well as prior work using the SOI-R (Edelstein et al., 2011; Puts et al., 2015), as we mention above. Consequently, we cannot rule out the possibility that our baseline results would differ had that survey included repeated sampling or, in addition, if the within-individual change component of our study included more frequent and more closely clustered follow-ups, rather than two interviews 4–5 years apart (Hsiao, 2007). Nonetheless, the large sample size and longitudinal nature of the study as well as our past relevant findings from this study, which relied on single sample T data, help to bolster our confidence in the results here (e.g. Gettler et al., 2011; Gettler et al., 2013; Gettler et al., 2017; Kuzawa et al., 2009). Similarly, our prior work has also generally shown larger effect sizes and/or more consistently significant relationships between men's evening T and demographic/behavioral measures (Gettler et al., 2012; Gettler et al., 2013; Gettler et al., 2017; Kuzawa et al., 2009). It is thought that evening T values may be more coupled to social dynamics, compared to waking T, which may have more tightly constrained production/functions related to sleep and anabolic processes (Gettler et al., 2013; Gray, Campbell, Marlowe, Lipson, & Ellison, 2004; Kuzawa, Georgiev, McDade, Bechayda, & Gettler, 2016; Muller & Wrangham, 2004).

Finally, our analyses in the present article focus solely on men who were single non-fathers at baseline and thus exclude the portion of the study sample who had transitioned to marriage and fatherhood in prior surveys. While we chose this analytical focus to isolate the effects of the transition to new parenting and partnering, we acknowledge that changes in men's sociosexuality for those who were already married or fathers are also theoretically important. However, among the pool of men in the CLHNS who were already married or fathers at baseline, few went through life history status changes in which we would predict that sociosexuality might rebound. For example, approximately 85% of those men were married residential fathers or married non-fathers at follow-up. Those are life history status categories in which we would predict men to have relatively muted changes

in sociosexuality. In addition, as part of our effort to test whether single non-fathers' sociosexuality was predictive of a faster life history strategy over the study period, we predicted men's likelihood of becoming nonresidential fathers. A more ideal, related test would have been whether single nonfathers with unrestricted sociosexuality were more likely to have fathered children by multiple women, but only two men in this sample acknowledged fitting this criterion. In total, there are a number of insights regarding longitudinal patterns of sociosexuality and male life history strategies that remain to be tested and may be more optimally operationalized in other cultural and ecological contexts.

## 5. Conclusions

In summary, our study was among the first to test for changes in men's sociosexuality through time and particularly related to life history transitions. Using longitudinal data, we find evidence that some aspects of between-individual differences in sociosexuality are not stable and trait-like. Rather, there is plasticity in sociosexuality psychology and behavior, and they are malleable and shift alongside other aspects of male reproductive effort. We also found theoretically-consistent but modest support for positive correlations between men's T and their sociosexuality. These findings make contributions to the literature regarding psychobiology and sociosexuality, including raising further questions as to why and how sociosexuality might be more strongly linked to T in some socio-ecological contexts and not others. Overall, our results provide novel insights regarding the facultative nature of men's sociosexual psychology and behavior and add to our growing understanding of factors shaping variation in male life history strategies.

**Data availability and study registration** — The data from this study will be available at <http://www.cpc.unc.edu/projects/cebu>. This study was not pre-registered.

**Funding** — This research was supported by funding from: The Wenner-Gren Foundation (Gr. 7356; Gr. 8186) and National Science Foundation (BCS-0542182; BCS-0962212; BCS-1317133).

**Competing interest statement** The authors have no competing interests

**Acknowledgments** — We thank our colleagues at the USC-Office of Population Studies Foundation (University of San Carlos, Metro Cebu, Philippines) and Linda Adair for their roles in study design and data collection. We also express our gratitude to the Filipino participants in this study for their long-term and ongoing participation in the CLHNS.

**Appendix A. Supplementary data** Supplementary materials for this article follow the Referemnces.

## References

- Adair, L. S., Popkin, B. M., Akin, J. S., Guilkey, D. K., Gultiano, S., Borja, J., ... Hindin, M. J. (2011). Cohort profile: The Cebu Longitudinal Health and Nutrition Survey. *International Journal of Epidemiology*, *40*, 619–625.
- Alvergne, A., Faurie, C., & Raymond, M. (2009). Variation in testosterone levels and male reproductive effort: Insight from a polygynous human population. *Hormones and Behavior*, *56*, 491–497.
- Bailey, J. M., Kirk, K. M., Zhu, G., Dunne, M. P., & Martin, N. G. (2000). Do individual differences in sociosexuality represent genetic or environmentally contingent strategies? Evidence from the Australian twin registry. *Journal of Personality and Social Psychology*, *78*, 537.
- Bribiescas, R. G., Ellison, P. T., & Gray, P. B. (2012). Male life history, reproductive effort, and the evolution of the genus *Homo*: New directions and perspectives. *Current Anthropology*, *53*, S424–S435.
- Busby, D. M., Christensen, C., Crane, D. R., & Larson, J. H. (1995). A revision of the Dyadic Adjustment Scale for use with distressed and nondistressed couples: Construct hierarchy and multidimensional scales. *Journal of Marital and Family Therapy*, *21*, 289–308.
- Carlson, D., Miller, A., Sassler, S., & Hanson, S. (2016). The gendered division of housework and couples' sexual relationships: A reexamination. *Journal of Marriage and the Family*, *78*, 975–995.
- Costa, R. M., & Brody, S. (2007). Women's relationship quality is associated with specifically penile-vaginal intercourse orgasm and frequency. *Journal of Sex & Marital Therapy*, *33*, 319–327.
- Del Giudice, M., Ellis, B. J., & Shirtcliff, E. A. (2011). The adaptive calibration model of stress responsivity. *Neuroscience and Biobehavioral Reviews*, *35*, 1562–1592.
- Edelstein, R. S., Chopik, W. J., & Kean, E. L. (2011). Sociosexuality moderates the association between testosterone and relationship status in men and women. *Hormones and Behavior*, *60*, 248–255.
- Edelstein, R. S., Chopik, W. J., Saxbe, D. E., Wardecker, B. M., Moors, A. C., & Labelle, O. P. (2017). Prospective and dyadic associations between expectant parents' prenatal hormone changes and postpartum parenting outcomes. *Developmental Psychobiology*, *59*, 77–90.

- Edelstein, R. S., van Anders, S. M., Chopik, W. J., Goldey, K. L., & Wardecker, B. M. (2014). Dyadic associations between testosterone and relationship quality in couples. *Hormones and Behavior*, *65*, 401–407.
- Edelstein, R. S., Wardecker, B. M., Chopik, W. J., Moors, A. C., Shipman, E. L., & Lin, N. J. (2015). Prenatal hormones in first-time expectant parents: Longitudinal changes and within-couple correlations. *American Journal of Human Biology*, *27*, 317–325.
- Farrelly, D., Owens, R., Elliott, H. R., Walden, H. R., & Wetherell, M. A. (2015). The effects of being in a “new relationship” on levels of testosterone in men. *Evolutionary Psychology*, *13*, 250–261.
- Gangestad, S., & Simpson, J. (1990). Toward an evolutionary history of female sociosexual variation. *Journal of Personality*, *58*, 69–96.
- Geary, D. C. (2000). Evolution and proximate expression of human paternal investment. *Psychological Bulletin*, *126*, 55–77.
- Gettler, L. T. (2010). Direct male care and hominin evolution: Why male-child interaction is more than a nice social idea. *American Anthropologist*, *112*, 7–21.
- Gettler, L. T. (2014). Applying socioendocrinology to evolutionary models: Fatherhood and physiology. *Evolutionary Anthropology*, *23*, 146–160.
- Gettler, L. T. (2016). Becoming DADS: Considering the role of cultural context and developmental plasticity for paternal socioendocrinology. *Current Anthropology*, *57*, S38–S51.
- Gettler, L. T., McDade, T. W., Agustin, S. S., Feranil, A. B., & Kuzawa, C. W. (2013). Do testosterone declines during the transition to marriage and fatherhood relate to men’s sexual behavior? Evidence from the Philippines. *Hormones and Behavior*, *64*, 755–763.
- Gettler, L. T., McDade, T. W., Agustin, S. S., Feranil, A. B., & Kuzawa, C. W. (2015). Longitudinal perspectives on fathers’ residence status, time allocation, and testosterone in the Philippines. *Adaptive Human Behavior and Physiology*, *1*, 124–149.
- Gettler, L. T., McDade, T. W., Bragg, J. M., Feranil, A. B., & Kuzawa, C. W. (2015). Developmental energetics, sibling death and parental instability as predictors of maturational tempo and life history scheduling in males from Cebu, Philippines. *American Journal of Physical Anthropology*, *158*, 175–184.
- Gettler, L. T., McDade, T. W., Feranil, A. B., & Kuzawa, C. W. (2011). Longitudinal evidence that fatherhood decreases testosterone in human males. *PNAS*, *108*, 16194–16199.
- Gettler, L. T., McKenna, J. J., Agustin, S. S., McDade, T. W., & Kuzawa, C. W. (2012). Does co-sleeping contribute to lower testosterone levels in fathers? Evidence from the Philippines. *PLoS One*, *7*, e41559.
- Gettler, L. T., Ryan, C. P., Eisenberg, D. T., Rzhetskaya, M., Hayes, M. G., Feranil, A. B., ... Kuzawa, C. W. (2017). The role of testosterone in coordinating male life history strategies: The moderating effects of the androgen receptor CAG repeat polymorphism. *Hormones and Behavior*, *87*, 164–175.
- Gonzales, T. P., Greer, J., Scheers, N. J., Oakes, E., & Buckley, J. (2004). Sources of resilience in the Filipino wife’s responses to spousal infidelity. *Philippine Journal of Psychology*, *37*, 74–103.

- Gray, P. B., & Anderson, K. G. (2010). *Fatherhood: Evolution and human paternal behavior*. Cambridge, MA: Harvard University Press.
- Gray, P. B., Campbell, B. C., Marlowe, F. W., Lipson, S. F., & Ellison, P. T. (2004). Social variables predict between-subject but not day-to-day variation in the testosterone of US men. *Psychoneuroendocrinology*, *29*, 1153–1162.
- Gray, P. B., McHale, T. S., & Carre, J. M. (2017). A review of human male field studies of hormones and behavioral reproductive effort. *Hormones and Behavior*, *91*, 52–67.
- Gray, P. B., Reece, J., Coore Desai, C., Dinall, T., Pellington, S., & Samms Vaughan, M. (2017). Testosterone and Jamaican fathers: Exploring links to relationship dynamics and paternal care. *Human Nature*, *28*, 201–218.
- Gray, P. B., Reece, J., Coore Desai, C., Dinnall Johnson, T., Pellington, S., & Samms Vaughan, M. (2015). Sexuality among fathers of newborns in Jamaica. *BMC Pregnancy and Childbirth*, *15*, 44.
- Havlicek, J., Husarova, B., Rezacova, V., & Klupilova, K. (2011). Correlates of extradyadic sex in Czech heterosexual couples: Does sexual behavior of parents matter? *Archives of Sexual Behavior*, *40*, 1153–1163.
- Holmboe, S. A., Priskorn, L., Jorgensen, N., Skakkebaek, N. E., Linneberg, A., Juul, A., & Andersson, A. (2017). Influence of marital status on testosterone levels- a ten year follow-up of 1113 men. *Psychoneuroendocrinology*, *80*, 155–161.
- Hsiao, C. (2007). Panel data analysis- advantages and challenges. *TEST*, *16*, 1–22.
- Jasienska, G. (2013). *The fragile wisdom: An evolutionary view on women's biology and health*. Harvard University Press.
- Kuzawa, C., McDade, T., Rosenbaum, S., Borja, J., & Gettler, L. (2018). Is the decline in testosterone with pairbonding or fatherhood attenuated as men age? The challenge of disentangling biology and selection in longitudinal analysis. *American Journal of Human Biology*, *30*, 24.
- Kuzawa, C. W., & Bragg, J. M. (2012). Plasticity in human life history strategy: Implications for contemporary human variation and the evolution of genus *Homo*. *Current Anthropology*, *53*, S369–S382.
- Kuzawa, C. W., Georgiev, A. V., McDade, T. W., Bechayda, S. A., & Gettler, L. T. (2016). Is there a testosterone awakening response in humans? *Adaptive Human Behavior and Physiology*, *2*, 166–183.
- Kuzawa, C. W., Gettler, L. T., Muller, M. N., McDade, T. W., & Feranil, A. B. (2009). Fatherhood, pairbonding, and testosterone in the Philippines. *Hormones and Behavior*, *56*, 429–435.
- Lawson, D. W., Nunez-De La Mora, A., Cooper, G. D., Prentice, A. M., Moore, S. E., & Sear, R. (2017). Marital status and sleeping arrangements predict salivary testosterone levels in rural Gambian men. *Adaptive Human Behavior and Physiology*, *3*, 221–240.
- Mascaro, J. S., Hackett, P. D., & Rilling, J. K. (2013). Testicular volume is inversely correlated with nurturing-related brain activity in human fathers. *PNAS*, *110*, 15746–15751.
- Mazur, A., & Michalek, J. (1998). Marriage, divorce, and male testosterone. *Social Forces*, *77*, 315–330.

- McIntyre, M., Gangestad, S. W., Gray, P. B., Chapman, J. F., Burnham, T. C., O'Rourke, M. T., & Thornhill, R. (2006). Romantic involvement often reduces men's testosterone levels—but not always: The moderating role of extra-pair sexual interest. *Journal of Personality and Social Psychology, 91*, 642–651.
- Medina, B. (2001). *The Filipino family*. Quezon City, Philippines: University of the Philippines Press (307 p).
- Muller, M. N., Marlowe, F. W., Bugumba, R., & Ellison, P. T. (2009). Testosterone and paternal care in East African foragers and pastoralists. *Proceedings of the Royal Society B, 276*, 347–354.
- Muller, M. N., & Wrangham, R. W. (2004). Dominance, aggression and testosterone in wild chimpanzees: A test of the 'Challenge Hypothesis'. *Animal Behaviour, 67*, 113–123.
- Olderbak, S. G., & Figueredo, A. J. (2010). Life history strategy as a longitudinal predictor of relationship satisfaction and dissolution. *Pers Individ Differ, 49*, 234–239.
- Penke, L., & Asendorpf, J. B. (2008). Beyond global sociosexual orientations: A more differentiated look at sociosexuality and its effects on courtship and romantic relationships. *Journal of Personality and Social Psychology, 95*, 1113.
- Puts, D. A., Pope, L. E., Hill, A. K., Cardenas, R. A., Welling, L. L., Wheatley, J. R., & Breedlove, S. M. (2015). Fulfilling desire: Evidence for negative feedback between men's testosterone, sociosexual psychology, and sexual partner number. *Hormones and Behavior, 70*, 14–21.
- Reise, S. P., & Wright, T. M. (1996). Personality traits, cluster B personality disorders, and sociosexuality. *Journal of Research in Personality, 30*, 128–136.
- Rodrigues, D., Lopes, D., & Pereira, M. (2017). Sociosexuality, commitment, sexual infidelity, and perceptions of infidelity: Data from the second love web site. *The Journal of Sex Research, 54*, 241–253.
- Roney, J. R., & Gettler, L. T. (2015). The role of testosterone in human romantic relationships. *Current Opinion in Psychology, 1*, 81–86.
- Saxbe, D. E., Edelstein, R. S., Lyden, H. M., Wardecker, B. M., Chopik, W. J., & Moors, A. C. (2017). Fathers' decline in testosterone and synchrony with partner testosterone during pregnancy predicts greater postpartum relationship investment. *Hormones and Behavior, 90*, 39–47.
- Schaller, M., & Murray, D. R. (2008). Pathogens, personality, and culture: Disease prevalence predicts worldwide variability in sociosexuality, extraversion, and openness to experience. *Journal of Personality and Social Psychology, 95*, 212.
- Schmitt, D. P. (2005). Sociosexuality from Argentina to Zimbabwe: A 48-nation study of sex, culture, and strategies of human mating. *Behavioral and Brain Sciences, 28*, 247–275.
- Simpson, J. A., & Gangestad, S. W. (1991). Individual differences in sociosexuality: Evidence for convergent and discriminant validity. *Journal of Personality and Social Psychology, (6)*, 870–883.
- Simpson, J. A., Wilson, C. L., & Winterheld, H. A. (2004). In J. Harvey, A. Wenzel, & S. Sprecher (Eds.). *Handbook of sexuality in close relationships* (pp. 87–111). Mahwah, NJ: Erlbaum Sociosexuality and romantic relationships.

- Sprecher, S., Treger, S., & Sakaluk, J. K. (2013). Premarital sexual standards and sociosexuality: Gender, ethnicity, and cohort differences. *Archives of Sexual Behavior, 42*, 1395–1405.
- Upadhyay, U. D., Hindin, M. J., & Gultiano, S. (2006). Before first sex: Gender differences in emotional relationships and physical behaviors among adolescents in the Philippines. *International Family Planning Perspectives, 32*, 110–119.
- van Anders, S. M. (2013). Beyond masculinity: Testosterone, gender/sex, and human social behavior in a comparative context. *Frontiers in Neuroendocrinology, 34*, 198–210.
- van Anders, S. M., Hamilton, L. D., & Watson, N. V. (2007). Multiple partners are associated with higher testosterone in north American men and women. *Hormones and Behavior, 51*, 454–459.
- Wlodarski, R., & Dunbar, R. I. (2015). Are within-sex mating strategy phenotypes an evolutionary stable strategy? *Human Ethology Bulletin, 30*, 99–108.
- Yabiku, S. T., & Gager, C. T. (2009). Sexual frequency and the stability of marital and cohabiting unions. *Journal of Marriage and the Family, 71*, 983–1000.
- Zheng, W. J., Zhou, X. D., Wang, X. L., & Hesketh, T. (2014). Sociosexuality in mainland China. *Archives of Sexual Behavior, 43*, 621–629.

## Supplementary Results and Materials

In the following repeated measures (RM) ANOVA models, the baseline and follow-up surveys are treated as a dichotomous time variable. The results in Table S1 reflect pairwise comparisons within each life history status group, contrasting baseline and follow-up values for each sociosexuality measure. In a RM ANOVA for global sociosexuality, there was a significant interaction between life history status and time [ $F(3, 284) = 2.68; 0.05$ ]. Similarly, in the model predicting sociosexual behavior, there was also a significant interaction between life history status and time [ $F(3, 284) = 2.79; 0.04$ ]. In the model for sociosexual desire, there was a main effect of life history status [ $F(3, 284) = 3.72; 0.01$ ] but not a significant main effect for time or an interaction between life history status and time (both  $p > 0.4$ ). Finally, in the model for sociosexual attitude, there was a main effect for time [ $F(1, 284) = 12.70; 0.0004$ ] but not a main effect for life history status or a significant interaction between life history status and time (both  $p > 0.2$ ). Because our primary focus in these models is to compare men's follow-up values to their own values at baseline, we likewise report the within-group comparisons for all sociosexual domains below.

<b>Table S1. Comparing men's follow-up (2014) sociosexuality to their own scores at baseline (2009), based on life history status at follow-up</b>			
<b>single non-F</b>	mean	SD	p value <sup>b</sup>
2009 global sociosexuality	24.05	9.69	
2014 global sociosexuality	23.03	9.37	0.16
2009 sociosexual behavior	6.18	3.95	
2014 sociosexual behavior	6.27	4.09	0.76
2009 sociosexual desire	6.20	3.23	
2014 sociosexual desire	5.99	3.63	0.45
2009 sociosexual attitude	11.66	5.68	
2014 sociosexual attitude	10.77	5.32	0.08
<b>single non-F to M res. F</b>			
2009 global sociosexuality	23.54	8.39	
2014 global sociosexuality	19.21	8.24	0.001
2009 sociosexual behavior	6.50	2.80	
2014 sociosexual behavior	5.27	2.43	0.002
2009 sociosexual desire	5.86	2.73	
2014 sociosexual desire	5.06	2.93	0.04
2009 sociosexual attitude	11.18	5.86	
2014 sociosexual attitude	8.88	5.50	0.002
<b>single non-F to M non-F</b>			
2009 global sociosexuality	27.44	11.40	
2014 global sociosexuality	23.44	9.94	0.03
2009 sociosexual behavior	7.04	3.74	
2014 sociosexual behavior	5.93	3.68	0.11
2009 sociosexual desire	7.70	4.37	
2014 sociosexual desire	7.33	4.97	0.58
2009 sociosexual attitude	12.70	5.07	
2014 sociosexual attitude	10.19	6.28	0.05
<b>single non-res F</b>			
2009 global sociosexuality	23.50	7.63	
2014 global sociosexuality	20.50	10.64	0.23
2009 sociosexual behavior	6.29	2.95	
2014 sociosexual behavior	5.50	2.95	0.42
2009 sociosexual desire	5.21	2.97	
2014 sociosexual desire	5.64	2.27	0.65
2009 sociosexual attitude	12.00	5.42	
2014 sociosexual attitude	9.36	7.27	0.14
<sup>a</sup> n = 288. F = father. res. = residential. M = married. sample sizes: single non-F, n = 163; M res. F, n = 84; M non-F, n = 27; single non-res. F, n = 14.			
<sup>b</sup> p values are from pairwise comparisons following repeated measures ANOVA and reflect the comparison of men's follow-up (2014) sociosexuality to their own levels at baseline (2009).			