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The Crowded Life Is a Slow Life: Population Density and Life History Strategy

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The world population has doubled over the last half century. Yet, research on the psychological effects of human population density, once a popular topic, has decreased over the past few decades. Applying a fresh perspective to an old topic, we draw upon life history theory to examine the effects of population density. Across nations and across the U.S. states (Studies 1 and 2), we find that dense populations exhibit behaviors corresponding to a slower life history strategy, including greater future-orientation, greater investment in education, more long-term mating orientation, later marriage age, lower fertility, and greater parental investment. In Studies 3 and 4, experimentally manipulating perceptions of high density led individuals to become more future-oriented. Finally, in Studies 5 and 6, experimentally manipulating perceptions of high density seemed to lead to life-stage-specific slower strategies, with college students preferring to invest in fewer rather than more relationship partners, and an older MTurk sample preferring to invest in fewer rather than more children. This research sheds new insight on the effects of density and its implications for human cultural variation and society at large.

Keywords: behavioral ecology, cross-cultural differences, life history theory, population density, time orientation

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In a classic study from the 1960s, rats were allowed to reproduce and multiply in confined spaces (Calhoun, 1962). The findings painted a troubling picture of how overcrowding might go wrong. Some rats became hyperactive and hypersexual, attempting to mate with adults and juveniles of both sexes. Others became socially disengaged, even though they were in perfect health. Yet others turned to cannibalism, feeding off dead infants despite sufficient food provision. Calhoun concluded that the observed pathologies were severe, noting ominously that future work might shed light on "analogous problems confronting the human species" (p. 148).

Coupled with social concerns about population growth, researchers began examining the psychological effects of density in humans. Some correlational studies found that higher density populations exhibited a range of behaviors labeled as pathological, including higher mortality, juvenile delinquency, and higher rates of psychiatric admissions (Cox, Paulus, & McCain, 1984; Galle, Gove, & McPherson, 1972). However, such relationships seemed to disappear when factors such as income and ethnicity were controlled for (Freedman, Heshka, & Levy, 1975; Mitchell, 1971). Experimental findings were also mixed. Some studies found that higher densities led to greater interpersonal hostility (Griffitt & Veitch, 1971) and poorer task performance (Martens & Landers, 1972), but others did not (Freedman, Klevansky, & Ehrlich, 1971; Smith & Haythorn, 1972). Subsequent reviews of the early empirical work concluded that, contrary to popular intuition, there was no clear relationship between population density and social pathology (Freedman, 1979; Lawrence, 1974). With a few exceptions (e.g., Gelfand et al., 2011; Levine, Martinez, Brase, & Sorenson, 1994), work on the psychological effects of density came to a halt.

We revisit here the question of density and human behavior through the lens of a theoretical framework from evolutionary biology—life history theory. We first introduce the general principles of life history theory and highlight recent applications of it to understanding human behavior, particularly the fast–slow strategy continuum. We then outline life history theory's predictions about density's effects, and present six studies examining these predictions. Finally, we discuss the implications of the current work for understanding the psychological effects of social density, and density's role as an ecological factor underlying societal-cultural differences.

Life History Theory

All living organisms face the problem of limited resources, such as time and energy. Given finite resources, decisions need to be made on how they are to be allocated. Life history theory provides a framework for conceptualizing how organisms allocate their

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limited time and energy to different tasks to attain reproductive success (Charnov, 1993; Del Giudice, Gangestad, & Kaplan, 2015; Kenrick & Griskevicius, 2015; Stearns, 1992).

Individual organisms can allocate energy to a wide range of tasks, which may fall under the broad categories of growth, maintenance, and reproduction (Gadgil & Bossert, 1970). Growth includes investments in physical growth, development of mental capacities, and the accumulation of skills and knowledge. This class of investment is referred to as embodied capital—bodily resources that have the potential to be used in the future. Individuals can also invest in bodily maintenance, such as the repair of physical tissue. Finally, individuals can invest in reproduction, which can span a wide range of tasks, from finding and competing for a reproductive partner to caring for one's offspring upon birth. The notion of trade-offs is central to life history theory, with energy devoted to one task being energy that cannot be used for another task. Hence, investment of energy in building one's own body or embodied capital means less energy available to spend on finding mates. Also, having many offspring means having less time and energy available to invest in each one.

Life history theory was originally developed to explain differences in energy investment patterns between species. For example, compared with elephants, mice reach sexual maturity much more quickly, and have more offspring but invest less in each one. Why? One factor relates to the different environments in which organisms live. Consider organisms that live in environments with high predation risks, and consequently high extrinsic mortality rates (i.e., threats to mortality over which an organism has relatively little control; Ellis, Figueredo, Brumbach, & Schlomer, 2009). For them, delaying reproduction into the future increases the probability of dying without reproducing. It may thus be more adaptive for organisms in such ecologies to invest their energy in early reproduction, even if that means investing less in their own embodied capital, bodily maintenance, and longevity. In such environments, offspring similarly face high extrinsic mortality rates. It is more adaptive in such a situation to have many offspring, even if that means being able to invest less in each. Having few offspring in a high mortality environment runs the risk that all of one's offspring will die before reproducing. Broadly then, in high extrinsic mortality environments, the more adaptive energy-allocation strategy is one that prioritizes rapid reproduction with high numbers of offspring.

Life history theory has also been applied to the study of *within*-species variation. If organisms face varying environmental conditions, and different resource allocation patterns are more or less adaptive in different environments, evolution would have selected for environmentally contingent flexibilities (Stearns, 1989; West-Eberhard, 1989). In other words, organisms should change their resource allocation strategies, in predictable ways, according to their current environment. For example, male salmon in some species can develop two different forms, a jack or hooknose (Gross, 1991). Jacks take about six months to reach sexual maturity whereas hooknoses take three times longer. The two forms are physically and behaviorally different. Hooknose males are larger in size and compete openly with other hooknoses for mates. Jack males, on the other hand, adopt a "sneak" mating strategy, fertilizing female eggs while avoiding detection by hooknoses. Ecological factors, such as predation pressure (generally an extrinsic mortality factor), shape whether individual salmon develop a jack or hooknose form. Lower levels of predation lead to more hooknoses, who delay their reproductive efforts as they focus instead on building embodied capital, facilitating competition for mates.

In sum, life history theory has been used to understand many between- and within-species differences, for a wide variety of traits and behaviors (e.g., Charnov & Berrigan, 1993; Crowl & Covich, 1990; Winemiller, 1989). Although the theory has had a strong presence in the fields of evolutionary biology and animal behavior for decades, its application to the study of human behavior is more recent.

Human Life History Strategies and the Fast–Slow Continuum

Humans also face the problem of limited resources. Relative to other primates, humans have a long period of juvenile growth, relatively later sexual maturity, slow rates of reproduction, relatively few offspring, and substantially higher investments in parental care (e.g., Kaplan, Hill, Lancaster, & Hurtado, 2000). Such a pattern of investment is often characterized as a *slow* life history strategy. A common theme underlying slow life history traits is the general engagement in behaviors, and investment in capacities, that are likely to have high returns *in the future* but little or no immediate benefit. A slow life history strategy is only adaptive insofar as the individual can expect to survive until such a future. A *fast* life history strategy, on the other hand, is characterized by the opposite traits—more rapid sexual maturation, early age of first reproduction, having many offspring but investing less in each offspring—and an increased focus on the present. A fast strategy is more adaptive when the future is less predictable and survival is less certain (e.g., high extrinsic mortality rates).

Although humans, as a species, generally fall at the slow end of the fast–slow strategy continuum, there is considerable variation between individuals in life history strategy (Belsky, Steinberg, & Draper, 1991; Chisholm, 1993; Ellis, 2004; Promislow & Harvey, 1990). Moreover, this variation is shaped by environmental factors (Ellis, Figueredo, Brumbach, & Schlomer, 2009). As with nonhuman animals, cues of extrinsic mortality appear to trigger faster life history strategies. For example, father absence is a potential indicator of a socially unpredictable environment in which a faster life history strategy would be more adaptive, and girls who grow up in father-absent homes reach puberty earlier that those in father-present homes (Ellis, McFadyen-Ketchum, Dodge, Pettit, & Bates, 1999). This parallels other work showing that where life expectancies are short, women tend to have earlier ages of first birth (Low, Hazel, Parker, & Welch, 2008; Wilson & Daly, 1997). Finally, a county-level analysis within the U.S. found that parents were also younger in counties with higher violent crime rates (Griskevicius, Delton, Robertson, & Tybur, 2011).

Fast versus slow life history strategies are characterized by more than just reproductive speed; they are also characterized by a wide variety of other traits and behaviors, including risk-taking, impulsivity, sexual promiscuity, social deviance, investment in education, and desire for children (Brumbach, Figueredo, & Ellis, 2009; Figueredo et al., 2005; Figueredo et al., 2006; Griskevicius et al., 2011; Kenrick & Gomez-Jacinto, 2014; Simpson, Griskevicius, Kuo, Sung, & Collins, 2012). Given that the fundamental currency of life history strategies is energy, and many traits and behaviors represent specific energy allocation patterns, it is not surprising that life history theory has implications for a wide range of traits and behaviors. Investment in education, for example, may be conceived of as an investment in embodied capital. The skills and knowledge acquired through education may have little immediate benefit but can carry large payoffs after an extended period of time.

Existing work has uncovered a range of factors that seem to influence individual life history strategies. In addition to factors mentioned above, other work has found potential effects of socioeconomic status (SES) and early childhood unpredictability (e.g., residential movement; Kotchick, Shaffer, Miller, & Forehand, 2001; Simpson et al., 2012), with lower SES and greater childhood unpredictability being associated with a faster life history strategy. Recent experimental work has also found that, when individuals are given information that there is increasing violence and death in their environment, they shift toward a faster life history strategy, becoming more present-oriented in a temporal discounting task (i.e., choosing a smaller immediate monetary reward over a delayed but larger reward; Griskevicius, Tybur, Delton, & Robertson, 2011). This effect was limited, however, to individuals from poorer childhood SES backgrounds—those who were more likely to grow up in harsher and less predictable environments.

Density and Life History Strategy?

Research on human life history has not focused on population density. Yet density was the key dimension of study when life history theory was first developed (MacArthur & Wilson, 1967; Reznick, Bryant, & Bashey, 2002). The central prediction was that low density should generally lead to fast reproduction, as rapid reproduction would allow faster exploitation of resources in an environment where food was abundant and there was little competition. On the other hand, under high population densities, to compete successfully with others for resources, organisms need to build competitive ability, often through investments in embodied capital. The same logic applies to offspring: although low densities and levels of competition allow having many offspring with minimal investment, under higher densities offspring may require a substantial degree of investment to become competitive enough to survive and reproduce. Thus, it would be more adaptive in high density environments to adopt a slower life history strategy—investing first in building one's capacities and then having fewer offspring, thereby allowing more resources to be invested in each individual offspring instead of dividing resources over many.

Indeed, in nonhuman animal work, density does seem to be associated with slower life history traits, in comparisons both across and within species. Animal populations that are more dense generally exhibit later sexual maturity, slower reproduction, fewer numbers of offspring, greater parental investment in offspring, and larger offspring size (as a result of resources devoted to few, instead of spread over many, offspring; e.g., Adler & Levins, 1994; Allen, Buckley, & Marshall, 2008; Creighton, 2005; Leips, Richardson, Rodd, & Travis, 2009; Meylan, Clobert, & Sinervo, 2007; Sinervo, Svensson, & Comendant, 2000). In one experiment, researchers placed female killifish in high or low density tanks, while keeping food provision per individual constant. After mating, each fish was isolated and, upon giving birth, offspring size and number were measured. As predicted, individuals from high density tanks had fewer but larger offspring compared with those from low density tanks (Leips et al., 2009).

Such effects of density on life history strategy could arise via multiple mechanisms. A mechanism of primary focus in nonhuman animal work is phenotypic plasticity (Pigliucci, 2005; West-Eberhard, 1989). To the extent that organisms have faced different ecologies in their ancestral history, and different behaviors are more adaptive in different ecologies, evolution would have selected for environmentally sensitive mechanisms that alter an organism's traits and behaviors according to the current ecology. In the case of density, if slower life history strategies are more adaptive in dense ecologies (by facilitating successful competition), one might expect organisms, including humans, to be sensitive to cues of density and to adopt slower life history strategies when density increases. Plasticity need not be the only mechanism operating, however, and we elaborate on this in the General Discussion.

In sum, we predict that high densities, in humans, will lead to a slower life history strategy. We examine this general prediction across multiple levels of analyses, utilizing a broad range of traits conceptually linked to life history strategy.

Current Research

In the current research, we explore the effects of population density through the lens of life history theory, using a combination of correlational and experimental methods. In Study 1, we test at the nation level the relationship between population density and a range of behaviors that are components of life history strategy. In Study 2, we examine similar relationships between population density and life history strategy, using data from the 50 U.S. states. In Studies 3 and 4, we test the effect of two different experimental manipulations of perceived density on a central component of life history strategy—future orientation. Finally, in Studies 5 and 6, we refine our experimental procedures and more broadly examine the effects of experimentally manipulated density on behaviors within different domains: education, mating, and parenting.

Study 1: Density and Life History Strategy Across Nations

In Study 1, we examine the relationship between population density and life history strategy at the level of nations, using a correlational design. To do so, we obtained information about population density and dependent measures from a number of databases. Dependent measures include a range of traits representing components of life history strategy, including mating behaviors, investment in self and offspring, and future orientation.

We predict, first, that people in denser countries will adopt the slow strategy of sexual restrictedness (Schmitt, 2005)—that they will be less sexually promiscuous and more highly invested in monogamous relationships. Note that this prediction runs counter to the intuition that crowded environments offer more opportunities for casual sex, and presumably lead to more sexual promiscuity.

Slow strategies include having fewer children (enabling one to invest more in each), and having children at a later age (enabling one to accumulate greater embodied capital prior to competing for mates and providing for offspring). We thus predict that people in higher density countries will have fewer children and lower rates of adolescent births. Although adolescent birth is likely to be highly related to fertility, these variables represent distinct constructs; whereas fertility represents total number of offspring, adolescent birth represents how early reproduction begins.

Slow strategies also include greater parental investment. We thus predict that dense countries will have a higher proportion of children being enrolled in preschool, a proxy for parental investment. We also predict that people in denser countries will be more future-oriented, a general theme underlying slow strategies, as mentioned earlier. Finally, we predict that residents of higher density countries will have longer life expectancies, given that slow strategists invest more in bodily maintenance and repair than do fast strategists, who trade off bodily maintenance and repair for early and frequent reproduction.

To summarize, in Study 1, we hypothesize that people living in denser nations will exhibit (a) greater sexual restrictedness, characterized by lower sexual promiscuity and greater commitment to long-term relationships, (b) lower levels of fertility, (c) later birth, as indexed by adolescent birthrate, (d) higher levels of parental investment, indexed by proportion of children enrolled in preschool, (e) a greater future time orientation, indexed by a survey measuring people's perceptions of future-oriented behavior in their own society, and (f) higher life expectancies.

Method

Population density. To assess population density, we obtained population size and land area data for all geopolitical regions listed in the CIA World Factbook for the years 2013, 2008, and 2003 (Central Intelligence Agency, 2013). The CIA World Factbook is an annually updated database compiled to contain a range of indicators—including geographical, population, economic, and health—on recognized geopolitical regions around the world. The number of geopolitical regions varied for each year, ranging from 236 to 227. Given that one of the life history strategy measures (future orientation) was from survey data collected in 1994, and density data from the Factbook were not available online for years before 2000, we obtained 1994 population density data from the World Bank (The World Bank, 2014). We chose these specific years to obtain density estimates that chronologically matched the approximate years for which data for the life history strategy variables were gathered.

Population density was computed by dividing population size by land area. Because density is highly skewed, we performed a logarithmic transformation (Gelfand et al., 2011). Population density across the selected years is highly correlated (rs $> .90$).

Life history strategy indicators. Sexual restrictedness data ($n = 48$) were obtained from previous cross-cultural work employing the Sociosexuality Orientation Inventory (SOI; Schmitt, 2005). Scores are created using a composite of several items, including items measuring attitudes toward casual sex (e.g., "Sex without love is OK") and actual sexual history (e.g., "With how many different partners have you had sex within the past year?"). Higher scores indicate a more unrestricted sociosexual orientation (i.e., greater promiscuity and low relationship investment). Schmitt and colleagues obtained SOI scores from over 14,000 individuals across 48 geopolitical regions. We use the separate mean scores for men and women in each region, and examine their correlations with population density during 2003.

Life expectancy ($n = 221$) and fertility ($n = 223$) measures were also obtained from the CIA World Factbook. Data from 2013 were used, and we examined their correlations with population density also at 2013. Fertility is the average number of children that would be born per woman if all women lived their full child-bearing years.

Adolescent birth ($n = 100$; percentage of births by women before age 18) and preprimary school gross enrollment ratio ($n = 158$), for both male and female children, were obtained from UNICEF (UNICEF, 2014). Data were available as averages from the time period 2008–2012. We correlated this with 2008 population density.

Finally, we also obtained a measure of future orientation from the GLOBE cross-national survey (House et al., 2004). These data were collected from more than 17,000 middle-managers in various industries, across 57 different nations. A sample item is "In this society people place more emphasis on (1 – Solving current problems, 7 – Planning for the future)." Higher scores reflect a greater future orientation. We utilized the nation-level mean scores ($n = 57$) for our analysis.[1]

Results and Discussion

Table 1 presents correlations of density and each life history variable, as well as intercorrelations among these variables. As predicted, people living in denser nations are more sexually restricted and have lower fertility, lower rates of early birth, higher rates of preschool enrollment, greater future time orientation (i.e., observations of people in the nation planning more), and higher life expectancies.

To facilitate a summary representation of density's effect on life history strategy, we created a life history strategy composite by first standardizing each life history variable, reverse-scoring variables where necessary such that higher scores would reflect a slower strategy. The z-scores were then summed to create the composite. However, we were forced to exclude the sociosexuality and future orientation measures, as including them would lead to an effective nation sample size of 6. The final composite of the four remaining life history variables had good reliability ($\alpha = .85$), and was indeed positively correlated with population density, $r(80) = .24$, $p = .034$ (see Figure 1).

Population density is associated with a variety of other factors, and it is possible that these other variables better explain the observed findings. For example, better health care, access to contraceptive methods, and educational facilities likely come with greater wealth and economic development. If dense regions are also wealthier, then our observed effects may be more a result of

[1] Note that the World Bank data had no population density information in 1994 for Taiwan and Kuwait, the latter because of the invasion by Iraq. So the final data sample was 55. Also the GLOBE survey contains two types of future orientation data, a Practice and a Values component. The former captures people's perceptions of how future-oriented their society *is*, whereas the latter is a measure of how future oriented people think their society *should be*. The two components are, in fact, negatively correlated (House et al., 2004). We use the Practice component in our analyses because we are interested in actual future orientation—how the societies are.

Table 1
Correlation Matrix of Nation Level Population Density and Life History Variables (Study 1)

Indicator (Year)	1	2	3	4	5	6	7	8
1. Population density (Year matched with each life history variable)	—							
2. Male sexual unrestrictedness[a] (~2003)	$-.41^{**}$ (*48*)	—						
3. Female sexual unrestrictedness[a] (~2003)	$-.35^{*}$ (*48*)	$.54^{***}$ (*48*)	—					
4. Fertility (2013)	$-.24^{***}$ (*223*)	$-.01$ (*48*)	$-.15$ (*48*)	—				
5. Adolescent birth rates (2008–2012)	$-.23^{*}$ (*100*)	$-.58^{*}$ (*13*)	$-.04$ (*13*)	$.67^{***}$ (*101*)	—			
6. Preschool enrollment rate (2008–2012)	$.22^{**}$ (*158*)	.06 (*43*)	$.26^{\dagger}$ (*43*)	$-.61^{***}$ (*156*)	$-.39^{***}$ (*80*)	—		
7. Future time orientation (~1994)	$.31^{*}$ (*55*)	$-.24$ (*29*)	.19 (*29*)	$-.09$ (*57*)	.22 (*22*)	$-.04$ (*48*)	—	
8. Life expectancy (2013)	$.35^{***}$ (*221*)	.08 (*48*)	.20 (*48*)	$-.80^{***}$ (*221*)	$-.59^{***}$ (*100*)	$.64^{***}$ (*156*)	.14 (*57*)	—

Note. *N*s for each correlation (italicized in parentheses) vary considerably depending on overlapping data availability. We caution about interpreting correlations between the life history variables (outside Column 1) given mismatches in the years data were collected and, in some cases, small sample sizes.
[a] Higher scores reflect greater sexual promiscuity.
$^{\dagger}p < .10$. $^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

wealth than density. To examine this, we obtained measures of per capita gross domestic product (GDP) from the CIA Factbook and the World Bank. Given high skew, we performed a logarithmic transformation on GDP per capita. First, denser regions had higher GDPs, $r(223) = .21$, $p = .002$. We then performed a series of regression analyses examining the effects of density controlling for per capita GDP, entering both population density and GDP as predictor variables for each of the life history strategy components, and also the life history composite. For all life history variables, population density remained a significant predictor even after controlling for per capita GDP (male/female sociosexuality: βs $= -.42$ and $-.41$, *p*s $= .004$ and $.002$; fertility: $\beta = -.11$, $p =$

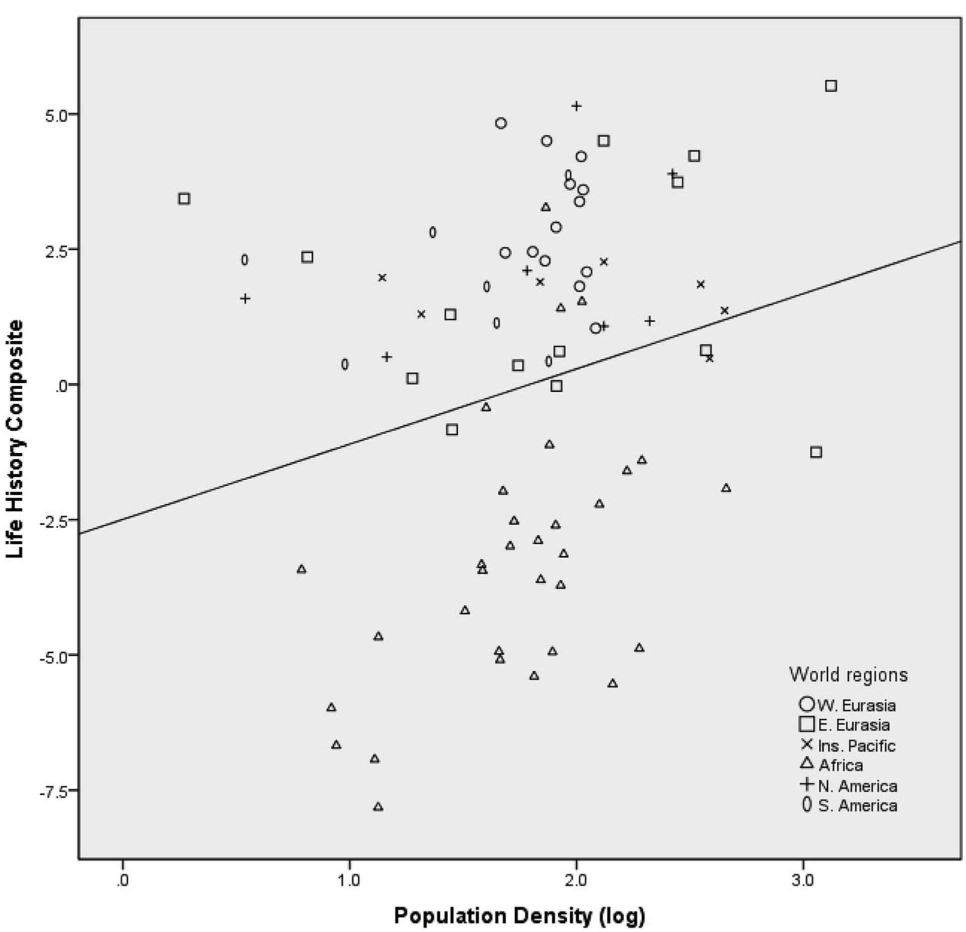

Figure 1. Nation level population density and composite life history strategy score (excluding sociosexuality and future orientation), identified by world region. Higher composite scores mean slower life history strategy.

.021; early births: $\beta = -.28$, $p = .002$; preschool enrollment: $\beta = .17$, $p = .003$; future orientation: $\beta = .27$, $p = .042$; life expectancy: $\beta = .19$, $p < .001$; life history composite: $\beta = .29$, $p < .001$).

Another possibility is that denser regions are also more urbanized, and it is urban culture per se that is generating the effects of population density (Greenfield, 2013). Indeed, high levels of urbanization are likely to be associated with a slow life history strategy, given that urbanization is an indicator of high geographic concentrations of a region's people within cities. Nonetheless, given that density is conceptually the more fundamental ecological dimension from a life history approach, we expected density's effects to hold even when controlling for the extent of urbanization. Urbanization data—the estimated percentage of a region's population that live in urban areas—were obtained from the World Bank. Density was marginally correlated with urbanization, $r(114) = .17$, $p = .072$. We then performed a series of regression analyses similar to those performed for per capita GDP. Once again, density's effects generally held controlling for urbanization, with the future orientation effect becoming marginal (male/female sociosexuality: βs $= -.48$ and $-.36$, ps $= .002$ and .028; fertility: $\beta = -.22$, $p = .017$; early births: $\beta = -.32$, $p = .013$; preschool enrollment: $\beta = .22$, $p = .038$; future orientation: $\beta = .24$, $p = .099$; life expectancy: $\beta = .20$, $p = .025$; composite: $\beta = .35$, $p = .015$).

Another possible confound is population *size*. Countries with high density are presumably also countries with a large population size. We have no a priori predictions, from a life history perspective, about the effects of population size. Nonetheless, due to reviewer requests, we attempted to control for it. We first log transformed population size, as we did for population density. The general correlation between density and population size was negative, $r(224) = -.13$, $p = .048$. We then repeated our main analyses controlling for population size. Controlling for population size, all of density's effects held (male/female sociosexuality: βs $= -.40$ and $-.33$, ps $= .005$ and .014; fertility: $\beta = -.22$, $p = .001$; early births: $\beta = -.23$, $p = .023$; preschool enrollment: $\beta = .20$, $p = .009$; future orientation: $\beta = .32$, $p = .020$; life expectancy: $\beta = .32$, $p < .001$; composite: $\beta = .24$, $p = .036$).

We also assessed whether the concept of tightness–looseness (Gelfand et al., 2011) could explain the relationship between density and the various life history variables. Tightness refers to the presence of stringent social norms in a society and low tolerance for deviation from such norms. To the extent that high density ecologies may lead to greater difficulties in social coordination, this leads to a greater need to enforce social norms. That said, there is no necessary conceptual link between tightness–looseness and slow-fast life history strategies, as a society could hypothetically have stringent norms promoting either a relatively fast strategy (e.g., have at least 3 children) or a relatively slow one (e.g., have no more than 1 child). In other words, tightness–looseness and the specific *content* of social norms are potentially independent. Nonetheless, we repeated our main analyses controlling for nation-level tightness indices (Gelfand et al., 2011). Note that the sample sizes for many of our analyses were dramatically reduced (ranging from Ns $= 5$ to 32), because of the lack of overlapping data for density, the specific life history variable, and tightness (for which data exists for 32 countries[2]; Gelfand et al., 2011). We thus recommend caution in interpreting these correlations. First, density is indeed correlated with tightness–looseness, $r(32) = .33$, $p = .063$; more dense countries are more tight, congruent with Gelfand et al.'s (2011) analyses.

Controlling for tightness–looseness, for male sociosexuality ($N = 23$), higher densities continue to predict more restricted male sociosexuality ($\beta = -.43$, $p = .036$); tightness showed a similar, but nonsignificant, relationship ($\beta = -.28$, $p = .16$). For female sociosexuality ($N = 23$), neither density nor tightness were significant predictors (density: $\beta = -.32$, $p = .15$; tightness: $\beta = -.23$, $p = .30$). For fertility ($N = 32$), denser nations continue to have lower fertility ($\beta = -.40$, $p = .031$), whereas tightness actually had a marginally significant reverse effect ($\beta = .35$, $p = .062$), with tighter nations exhibiting *higher* fertility. For adolescent birth ($N = 5$), neither density nor tightness were significant predictors (density: $\beta = -.55$, $p = .59$; tightness: $\beta = .58$, $p = .58$). For preschool enrollment ($N = 27$), neither density nor tightness were significant predictors (density: $\beta = .16$, $p = .44$; tightness: $\beta = -.26$, $p = .20$). This was also the case for life expectancy ($N = 32$; density: $\beta = .19$, $p = .33$; tightness: $\beta = -.19$, $p = .34$). Finally, for future orientation ($N = 25$), density did not have a significant effect ($\beta = .22$, $p = .28$), but tightness had a marginally significant effect ($\beta = .38$, $p = .066$), with tighter nations being more future oriented. To summarize, while controlling for tightness–looseness, density remained a significant predictor of male sociosexuality and fertility even with the reduced sample, and all the nonsignificant correlations remained in the predicted direction. Tightness marginally predicted future-orientation, with tighter nations being more future-oriented. Tightness also marginally predicted fertility, but in the opposite direction than one might expect, with tighter nations having *higher* fertility. Again, we recommend caution in interpretation given the small samples. Similar analyses at the U.S. state level (Study 2), for which there were complete data for all 50 states, may be more instructive.

Finally, some have noted that using nations as units of analysis violates the assumption of independence (i.e., Galton's problem), as geographically adjacent countries may share a variety of similarities with one another (Pollet, Tybur, Frankenhuis, & Rickard, 2014). Others have argued against this as a problem (Thornhill & Fincher, 2013). We note first that this is a complex issue for which there seems no clear consensus on any single solution. Nevertheless, to examine this, we used three different analysis strategies. First, following procedures adopted by existing work (e.g., Fincher & Thornhill, 2012; Schaller & Murray, 2011), we assigned the countries in our sample into the six world regions defined by Murdock (1949), according to geographical proximity and shared cultural histories. We then examined the correlations between the regional aggregate scores for density and each life history variable. This analysis strategy assumes that there are only six independent units of analysis (world regions). Given the small sample size ($n = 6$), p values are less meaningful here; instead, the focus of this analysis is to examine the direction of the correlations to determine if they remain consistent. We found that the correlations of density

[2] Note that the full sample for Gelfand et al.'s (2011) indices is 33, as there are separate data for East and West Germany. Given that our own measures do not make this distinction, we combined the tightness scores for East and West Germany into an average score for Germany.

with the life history variables all remained in the same direction (sociosexuality male/female: $r = -.82/-.68$; fertility: $r = -.66$; adolescent birth: $r = -.55$; preschool enrollment: $r = .24$; future orientation: $r = .24$; life expectancy: $r = .55$; life history composite: $r = .18$).

Our second approach was to examine density's effects by controlling for world region. World region was dummy coded and entered into a simultaneous regression with population density predicting each of the life history variables, and the life history composite. For the individual variables, controlling for world region, population density continued to significantly predict more restricted female sociosexuality ($\beta = -.44$, $p = .021$), higher preschool enrollment ($\beta = .17$, $p = .017$), greater future orientation ($\beta = .32$, $p = .025$), and higher life expectancy ($\beta = .18$, $p < .001$), but no longer significantly predicted male sociosexuality ($\beta = -.09$, $p = .59$), fertility ($\beta = -.06$, $p = .26$), and teenage births ($\beta = -.10$, $p = .23$). For the general life history composite, population density continued to predict a slower strategy ($\beta = .17$, $p = .017$).

Our third analysis strategy examined correlations between population density and the life history variables *within* each world region. If population density is indeed influencing life history strategy, one might expect to see similar associations within each of the presumably independent world regions (for a similar strategy in relation to pathogen prevalence, see Hruschka & Hackman, 2014). Given the generally reduced sample sizes when examining correlations within each region (average $n = 20$), most correlations were not statistically significant (see supplemental material for full analyses). We summarize here a general pattern in terms of the number of correlations that were at least .24 in magnitude (using the correlation between density and the life history composite as a benchmark), for both correlations that were directionally consistent with predictions, or opposite.

Of a total of 42 correlations for all 6 regions, 20 were in the predicted direction, and 4 were opposite. The distributions across each region were: Western Eurasia, 4 (of 7) consistent; Eastern Eurasia, 5 consistent, 1 opposite; Insular Pacific, 2 consistent; Africa, 3 consistent, 1 opposite; North America, 2 consistent, 2 opposite; South America, 4 consistent. Hence, within regions, higher densities also seemed to be generally associated with a slower life history strategy.

Finally, we note that from Figure 1, it appears that density's association with the life history composite may be driven primarily by African countries, which are relatively low in density and also faster life history compared with the other countries. We remind here that the composite did not include sociosexuality and future orientation, as attempting to include them would have reduced the sample size to 6 nations. To further examine this, we reran the individual correlations between population density and the life history variables, excluding all African countries. Focusing on just non-African countries, greater population density was still associated with more restricted male and female sociosexuality [$r(43) = -.59$ and $-.41$, $p < .001$ and .006, respectively], greater preschool enrollment [$r(117) = .19$, $p = .044$], greater future orientation [$r(48) = .31$, $p = .032$], and higher life expectancies [$r(167) = .29$, $p < .001$]. Density was no longer significantly correlated with teenage births [$r(58) = .02$, $p = .86$], or fertility [$r(168) = -.13$, $p = .10$], with the latter nonetheless in the predicted direction.

In sum, across nations, we find that denser populations show a host of traits corresponding to a slower life history strategy: They plan more for the future, are oriented toward committed long-term relationships, have children later, have fewer children, are more likely to invest in their children's education, and are more likely to live longer. These effects were robust when taking into account economic development, urbanization, and population size. In addition, density's general association with a slow strategy seemed to hold under a range of analyses addressing problems of nonindependence.

Nevertheless, given the variety of issues and unexamined confounds accompanying such nation-level correlations, we sought to further examine density's effects at a different level of analysis—within a country.

Study 2: Density and Life History Strategy Across U.S. States

To assess whether the findings of Study 1 replicate at finer-grained levels of society, Study 2 examines the relationships between population density and components of life history strategy *within* the U.S., using the 50 U.S. states as units of analysis. As before, dependent variables include a range of traits representing components of life history strategy, including mating behaviors, investment in self and offspring, and time orientation.

Method

In Study 2, we draw upon demographic data at the state level, across the 50 U.S. states. Matching the same variables at the nation level, we examined state-level fertility, teenage pregnancy rates, preschool enrollment, and life expectancy. We were unable to obtain comparable sexual restrictedness data at the U.S. state level.[3] We were, however, able to obtain additional proxies of life history strategy, namely state-level data on median first age of marriage, percentage of adults with a bachelor's degree or higher, and percentage of employed individuals who participated in a retirement plan. For these new measures, we predicted that (a) people in denser states will have a later age of marriage, tracking the delayed reproduction characterizing a slow life history strategy; (b) people in denser states will be more likely to invest in education—embodied capital from a life history perspective, which pays off only after an extended period of time; and (c) people in denser states will be more likely to invest in retirement plans, a future-oriented behavior.

Population density. State-level population density ($n = 50$) was obtained from the U.S. Census Bureau for the year 2008

[3] We note that the Centers for Disease Control have data from the Youth Risk Behavior Surveillance Survey that contains potentially relevant variables. Specifically, the survey collected data on the percent of high school respondents in each U.S. state who have had sexual intercourse by age 13, and who have had at least four sexual partners. However, there are multiple issues with these data, such as statistical skew, incomplete data across states, and potential social desirability issues in such self-reports. Given this, we do not include these analyses in the text, but will provide the relevant data upon request. We thank an anonymous reviewer for pointing us to these data, and also note the importance of future work examining the relationship between social density and reliable indicators of sexual restrictedness.

(Census Bureau, 2014). The distribution was again highly skewed, so we performed a logarithmic transformation.

Life history strategy indicators. From the U.S. Census Bureau we obtained life expectancy data (2010), teenage pregnancy (2008, measured as birth rates for teenagers ages 15–19), fertility (2008), and median age of first marriage for both men and women (2008; Census Bureau, 2014).

Data for preschool enrollment and for adults with bachelor degrees or higher were obtained from the website KidsCount (KidsCount, 2014), which collates various indices of education from the U.S. Census Bureau. Preschool enrollment was measured as the percentage of children between 3 to 5 years old in each state enrolled in preschool, averaged across 2008 to 2010. Prevalence of bachelor's degrees was measured as the percentage of adults 25 to 29 years old with a bachelor's degree or higher. We used data from 2012 for this variable, given that our density index was from 2008, coupled with the premise that bachelor degrees generally take 4 years. Finally, data on percentage of workers participating in an employment-based retirement plan were obtained from the Employee Benefit Research Institute. Data were available for the year 2012 (Employee Benefit Research Institute, 2014).

Results and Discussion

We summarize our findings in Table 2. As predicted, residents of denser states married later and had lower fertility, lower rates of early birth, higher rates of preschool enrollment, greater future time orientation (i.e., greater proportion of individuals investing in retirement), and a greater investment in embodied capital (i.e., greater proportion of higher education degrees). The one prediction that was not borne out at the U.S. state-level was life expectancy—denser states did not have significantly higher life expectancies.

Similar to Study 1, we computed a life history composite (α = .89) by summing the standardized scores of the life history variables (excluding life expectancy), recoded such that higher scores represent a slower life history strategy. Population density was indeed positively associated with the general life history composite, r = .63, p < .001 (see Figure 2).

As in Study 1, we also examined whether the effects of population density could be explained by state-level differences in economic development, urbanization, population size, or tightness–looseness. State-level real GDP per capita for 2008 was obtained from the U.S. Bureau of Economic Analysis (Bureau of Economic Analysis, 2010). As per the nation-level analysis, per capita GDP was log transformed to reduce skew. Urban population percentage at the state level was obtained from the Census Bureau (Census Bureau, 2014). Data were available for the year 2000. Finally, tightness–looseness indices at the U.S. state level were obtained from existing work (Harrington & Gelfand, 2014).

First, density was unrelated to GDP per capita, $r(50)$ = .13, p = .36, and denser states had higher levels of urbanization, $r(50)$ = .47, p = .001. Controlling for state-level GDP, all the effects of density held, with the exception of retirement planning (fertility, $\beta = -.50$, p < .001; teenage birth: $\beta = -.27$, p = .040; male/female marriage age: βs = .45 and .62, respectively, both ps < .001; preschool enrollment: β = .65, p < .001; higher education completion: β = .44, p < .001; retirement plans: β = .21, p = .13). Controlling for urbanization, all of density's effects held (fertility, $\beta = -.71$, p < .001; teenage birth: $\beta = -.30$, p = .058; male/female marriage age: β = .37, p = .010, and β = .60, p < .001, respectively; preschool enrollment: β = .69, p < .001; higher education completion: β = .47, p = .002; retirement plans: β = .34, p = .035).

Similar to Study 1, we also attempted to control for population size at the U.S. state level. First, denser states had larger population size, $r(50)$ = .57, p < .001. Controlling for raw population size, the effects of density all held (fertility, $\beta = -.71$, p < .001; teenage birth: $\beta = -.54$, p = .001; male/female marriage age: β = .65 and .75, respectively, both ps < .001; preschool enrollment: β = .78, p < .001; higher education completion: β = .60, p < .001; retirement plans: β = .47, p = .006).

Again, we also assessed whether tightness–looseness could account for the relationship between density and the various life history variables at the U.S. state level. First, as with Harrington and Gelfand (2014), we find that density at the U.S. state level does not correlate with tightness–looseness, $r(50) = -.05$, p = .75. Controlling for tightness–looseness, higher density continued to predict slower life history behaviors [fertility, $\beta = -.49$, p < .001; teenage birth: $\beta = -.29$, p = .005; male/female marriage age: β = .47 and .64, respectively, both ps < .001; preschool enrollment: β = .68, p < .001; higher education completion: β = .48, p < .001; retirement plans: β = .24, p = .092], with the relationship between density and retirement plans being marginally significant. In contrast, controlling for density, tightness

Table 2
Correlation Matrix of U.S. State Level Population Density and Life History Variables (Study 2)

Indicator (Year)	1	2	3	4	5	6	7	8	9
1. Population density (2008)	—								
2. Male marriage age (2008)	.50***	—							
3. Female marriage age (2008)	.66***	.87***	—						
4. Fertility (2008)	−.50***	−.64***	−.63***	—					
5. Teenage birth rates (2008)	−.32*	−.57***	−.54***	.41**	—				
6. Preschool enrollment rates (2008–2010)	.69***	.52***	.65***	−.40**	−.43**	—			
7. Degree completion rates (2012)	.50***	.55***	.63***	−.46**	−.80**	.67***	—		
8. Retirement plan participation (2012)	.25†	.17	.25†	−.27†	−.63***	−.63***	.62***	—	
9. Life expectancy (2010)	.13	.51***	.44**	−.05	−.75***	−.75***	.57***	.28*	—

Note. All ns = 50.
† p < .10. * p < .05. ** p < .01. *** p < .001.

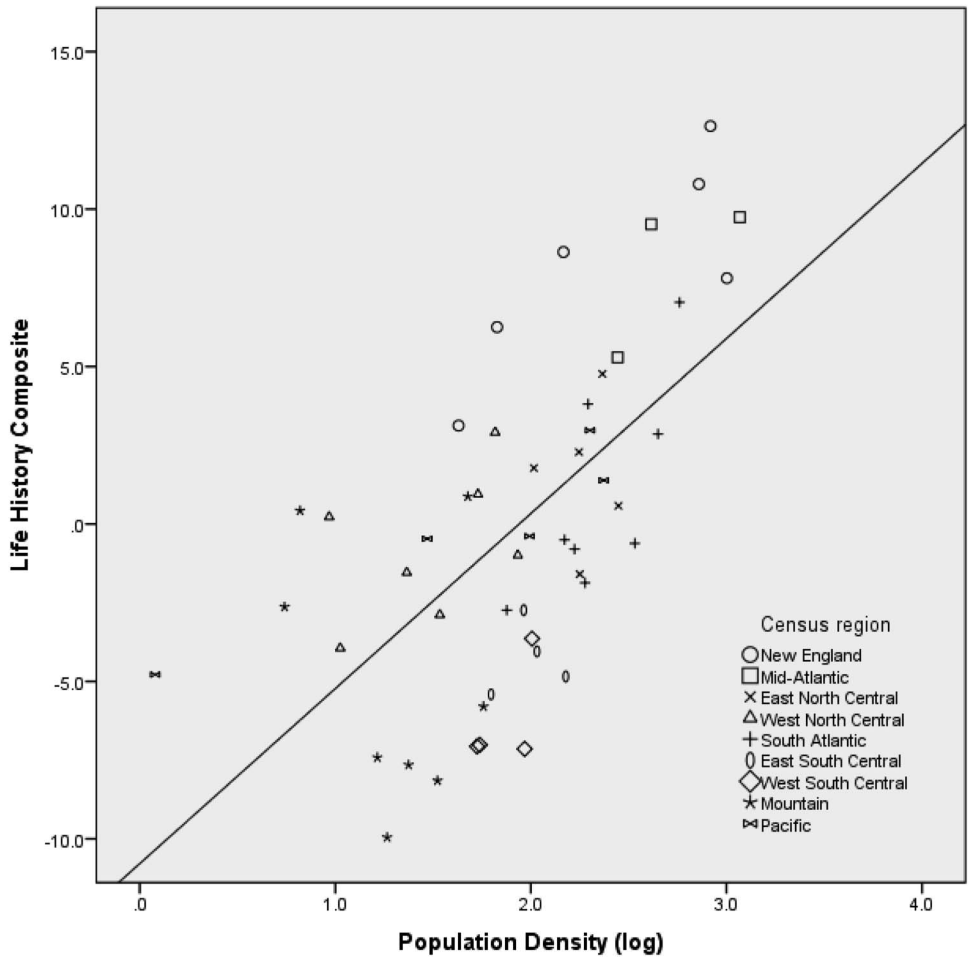

Figure 2. U.S. state level population density and composite life history strategy score, identified by census region. Higher composite scores mean slower life history strategy.

tended to predict *faster* life history behaviors, with tighter states having higher teenage birth rates ($\beta = .66$, $p < .001$), earlier marriage ages (male: $\beta = -.59$, $p < .001$; female: $\beta = -.44$, $p < .001$), and lower rates of higher education completion ($\beta = -.36$, $p = .003$); this same pattern was also observed for the other life history variables, although not significantly [fertility: $\beta = .19$, $p = .13$; preschool enrollment: $\beta = -.07$, $p = .53$; retirement plans: $\beta = -.20$, $p = .16$]. That tightness seems to predict faster life history strategies at the U.S. state level, controlling for density, is interesting, and we return to this in the General Discussion. Importantly, for the current study, tightness–looseness does not appear to account for density's association with life history behaviors at the U.S. state level.

Finally, similar to Study 1, to address the issue of nonindependence, we carried out the same set of analysis strategies. First, we grouped the U.S. states into nine distinct regions, as defined by the U.S. Census Bureau (similar groupings have been previously used by Fincher & Thornhill, 2012). We then examined the correlations between region-level aggregates of population density and the life history variables. Using these presumably more independent units of analysis, all of density's effects remained in the predicted direction (fertility: $r = -.87$; teenage birth: $r = -.47$; male/female marriage age: $r = .65/.79$; preschool enrollment: $r = .87$; higher education completion: $r = .65$; retirement plans: $r = .48$).

Next, we examined density's effects when controlling for census region. For the individual life history variables, population density continued to predict both male and female marriage age (βs = .31 and .42, *p*s = .030 and .002, respectively), preschool enrollment ($\beta = .59$, $p < .001$), and higher education completion ($\beta = .40$, $p = .010$), but did not significantly predict fertility ($\beta = -.02$, $p = .92$), teenage births ($\beta = -.12$, $p = .31$), and retirement participation ($\beta = .02$, $p = .91$).[4] For the general life history composite, population density continued to predict a slower strategy ($\beta = .35$, $p = .002$).

Following Study 1, the final analysis examined individual correlations between population density and the seven life history

[4] Unexpectedly, controlling for region, the originally nonsignificant association between density and life expectancy was now significant—in the predicted direction of denser states having higher life expectancies ($\beta = .40$, $p = .002$).

variables within each census region (full analyses in supplemental material). Again, using the magnitude of the correlation between density and the life history composite as a criterion (r = .63), we summarize the number of correlations that are both consistent and contrary to predictions. Of 63 total possible correlations, 22 were consistent, and 6 were opposite. The region distributions of the correlations were: New England, 4 (of 7) consistent; Mid-Atlantic, 3 consistent, 1 opposite; East North Central, 2 opposite; West North Central, 1 consistent; South Atlantic, 4 consistent; East South Central, 2 consistent, 2 opposite; West South Central, 3 consistent, 1 opposite; Mountain, no consistent or opposite; Pacific, 5 consistent.

In sum, across nations and within the U.S., we find that denser populations show a host of traits corresponding to a slower life history strategy: They plan more for the future, are oriented toward committed long-term relationships, are more likely to invest in their own education, marry later, have children later, have fewer children, and invest in their children's education. These relationships generally held controlling for per capita GDP, urbanization, and population size, at the nation and U.S. state level, and tightness–looseness at the U.S. state level, suggesting again that the relationship between density and slow strategies is robust.[5]

A critique of correlational analyses is that there may be unmeasured confounding variables. We have accounted here for multiple potential alternatives, and density's effects generally held. Certainly, there may be other alternatives that remain. In addition, the units of analyses in these two studies (countries, U.S. states) pose a nonindependence problem, because of potential similarities between units (e.g., shared histories, languages, diets) (for more detailed discussions, see Hruschka & Hackman, 2014; Pollet, Tybur, Frankenhuis, & Rickard, 2014). Although we have made an initial attempt to address this with the various region-level analyses, they may nonetheless be inadequate. Hence, we recommend caution in interpreting the current patterns.

To further test the current hypotheses, we examine in Studies 3 and 4 the effects of two different experimental manipulations of perceived density on a general psychological component underlying life history strategy—present versus future time orientation. We predict that individuals led to perceive high social densities will shift toward a greater future orientation, in accordance with a slower life history strategy.

Study 3: Manipulated Density and Temporal Discounting I

To induce perceptions of higher social density, participants in Study 3 read an article describing increasing population growth and densities in the U.S., after which they completed a financial temporal discounting scale measuring how much they were willing to wait for a larger reward. Temporal discounting measures—in which individuals are presented with a series of hypothetical choices assessing preferences for a specific amount of money now versus a larger sum later—have been previously used as an indicator of life history strategy (Griskevicius et al., 2011). Such a measure is conceptually equivalent to the future orientation measure in Study 1 and the retirement investment measure in Study 2, and enables an assessment of the general slow life history inclination to trade off immediate benefits for potentially greater future benefits.

Method

Participants. Two hundred sixty-five participants (134 women) were recruited from Amazon's Mechanical Turk and compensated 50 cents. The mean age of these participants was 35.3 years (SD = 12.8). Eleven participants did not complete the temporal discounting dependent measure and were excluded from the analysis.

Procedure. Participants signed up for a study advertised as a "Social Decisions Survey." Participants previewing the task read the participant consent form and were then directed to a link where they could complete the survey. Upon entering the survey, participants randomly assigned the density condition read a fictitious newspaper article, under the pretext that the study was about how individuals would relate to different types of information and that their memory for the article would be tested later. Participants randomly assigned to the control condition read no article but instead began with the temporal discounting measure.

Participants in the density condition read an article titled "The Crowded Life: Too Many, Too Much," which described how populations were growing at unprecedented rates within the United States. The article was formatted to look like a *New York Times* article and actual population growth statistics from various cities were included to increase its apparent authenticity. The article also described interviews with individuals in various settings, such as parks, shopping malls, and colleges, who expressed feeling the increasing crowdedness in their environments. For example, as part of the article, participants read:

> A few months ago, Bob Buckley and his family made their way to a local park on a sunny spring day. When they got there, they were shocked to find the park overrun with people. With no space to themselves, Bob's family couldn't help running into people— literally. They attempted to play soccer in a cramped field or find an open swing on a crowded playground, but in the end, there were just too many people. When asked about how he felt, Bob responded, "I felt very cramped and constrained. There were so many people, and no open space. It's like everywhere else these days—full of people." . . . Throughout the United States, people are becoming increasingly familiar with long lines, big crowds, and giant traffic jams. There's a good reason for all this overcrowding. According to statistics released

[5] An alternative approach is that high density, in addition to cueing the presence of high levels of social competition, might also cue high levels of social cooperation—and perhaps perceptions of social cooperation contribute to a slow life history strategy. We thank a reviewer for suggesting this possibility. In an initial test of this alternative, we gathered data, at both the nation and state levels, on the GINI coefficient of social inequality, given that lower inequality within a society might reflect greater social cooperation. We then carried out mediation analyses testing the idea that high density predicts greater social cooperation (indicated by low GINI) which in turn predicts slower life history behaviors. At neither the nation nor U.S. state level did we see any evidence for the social cooperation hypothesis. If anything, GINI may have suppressed the magnitude of the observed effects of density on life history behaviors. Specifically, within the U.S., states with higher density were associated with higher (rather than lower) inequality, which in turn predicted *faster* life history behaviors (i.e., higher rates of teenage births and lower rates of retirement participation). Thus, the relationship between density and the life history variables is strengthened when inequality is taken into account. However, given that there are no consistent patterns across the dependent variables at the U.S. state level, and no evident patterns at the nation level, we are wary of drawing any clear conclusions.

> by the U.S. census this year, population densities are growing at an unprecedented rate. In almost every U.S. state, population densities are increasing rapidly. The population of Phoenix, Arizona, for example, was just over 100,000 in 1950. Now the Phoenix area is tipping the scales at over 4.3 million! And Phoenix isn't even the fastest growing American city. Three cities in Texas alone—Houston, Austin, and San Antonio are growing even more rapidly . . .

Given the dependent variable in the current study, care was taken to not include any content that made explicit reference to financial decisions. Pilot testing using an independent sample showed that participants who read the article were more likely to perceive that density around them would increase (3 item composite: "Do you think your surroundings will get more or less crowded in future?," "Do you think there will be fewer or more people around you in future?," "Do you think there will be less or more space available to you in future?" [reverse-coded] from 1 = *definitely less crowded/fewer people/less space* to 7 = *definitely more crowded/more people/more space*, $\alpha = .80$), compared with participants who did not read the article, $t(111) = -5.65$, $p < .001$. After reading the article, participants responded to the temporal discounting measure, as described below.

Time orientation task. To assess future orientation, participants then provided responses to an ostensibly unrelated nine-item financial temporal discounting task drawn from previous research (Griskevicius et al., 2011). A sample item is "Would you want to get $100 tomorrow or $150 90 days from now?" (Study 3 $\alpha = .82$; Study 4 $\alpha = .84$), with higher scores representing an inclination to wait for the larger reward, or a more future-oriented time perspective.

Subjective socioeconomic status. Participants then completed two measures of subjective socioeconomic status, both childhood (e.g., "My family usually had enough money for things when I was growing up," $\alpha = .85$), and current (e.g., "I have enough money to buy the things that I want," $\alpha = .91$; Griskevicius et al., 2011). We included these measures for exploratory purposes, given previous findings that mortality cues lead to different life history strategies depending on childhood SES (see General Discussion and supplementary material).

Results and Discussion

As predicted, participants who were exposed to the high density manipulations exhibited a greater preference for the delayed larger reward than did control participants (see Figure 3), $t(252) = -2.08$, $p = .038$, $d = .26$. This replicates, experimentally, the relationships between density and future orientation observed in Studies 1 and 2. Individuals presented with information that populations were becoming denser adopted a greater future-orientation, as revealed by preferences for delayed but larger rewards.

Study 4: Manipulated Density and Temporal Discounting II

To induce perceptions of higher social density, participants in Study 3 read a fictitious article describing increasing population growth and densities in the U.S. One concern here, however, is that the content of the article may have led individuals to think about the future, given the discussion of growing population densities,

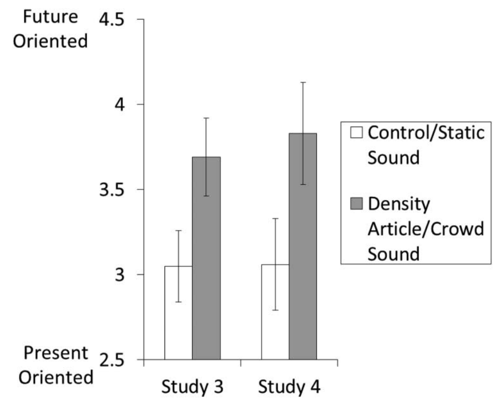

Figure 3. Density manipulation effects on time orientation in Studies 3 and 4. Higher scores mean greater preference for delayed larger rewards (i.e., future orientation). Error bars represent ± 1 *SE*.

and that this may be what triggered the observed future orientation. Hence, in Study 4, we replicate Study 3 using a different and more content-free cue to high density—the sound of a crowd.

Method

Participants. One hundred seventy-five Mechanical Turk participants (90 women), mean age 37.2 years ($SD = 13.0$) received 50 cents for participating. Eleven participants were excluded from the analysis because they reported being unable to hear the sound clip, and one participant was excluded because he did not respond to the sound check question.

Procedure. As in Study 3, participants signed up for a study advertised as a "Social Decisions Survey," and were randomly assigned to listen to one of two sound clips prior to completing the temporal discounting task.

Participants were asked to find a quiet place, to imagine themselves in the environment of the sound clip, and to think about how they would feel in that place. In the density condition, participants listed to a minute-long sound clip consisting of crowd conversation noise, in which there were no distinct words or individual conversations. In the control condition, participants listened to a similarly long sound clip consisting of white noise. Both sound clips were obtained from an online sound clip repository (SoundJay, 2014). In a pretest using an independent sample, 40 individuals heard one of the two sound clips and rated their perceptions of how crowded the sound environment was (1 = *Not at all*, 7 = *Extremely*) and estimated the number of people in the sound environment (1 = *None*, 7 = *Many*). Individuals hearing the density clip rated the sound environment as being more crowded and as having more people, compared with those who heard the static noise (both $ps < .001$). In addition, the two sound clips were rated as comparably loud (i.e., "How loud was the sound clip?" from 1 = *Not at all*, to 7 = *Extremely*), $p = .10$. Finally, there were also no significant differences between the two clips in the extent of 10 emotions elicited after listening: *anger, fear, content, amused, proud, disgust, hopeful, gratitude, sadness,* and *nurturing* ("How much do you feel (emotion)?," 1 = *Not at all* to 7 = *Extremely*), all $ps > .21$.

After listening to the sound clip, participants were told that they would be asked questions about the clip later. Also, given that this was an online sample, and participants might not have been able to load the sound clip for technical reasons, we included a check question asking whether participants were able to hear the clip.

To assess future orientation, participants then completed the same financial temporal discounting task used in Study 3. They also then completed measures of both childhood and current SES.

Results and Discussion

As in Study 3, and as predicted, participants exposed to the high density manipulation exhibited a marginally greater preference for the delayed larger reward than did control participants (see Figure 3), $t(161) = -1.92$, $p = .057$, $d = .30$.

In sum, both Studies 3 and 4 experimentally replicate the correlational relationships between density and future orientation observed in Studies 1 and 2. Individuals presented with information that populations were becoming denser, or with sounds of a crowded environment, adopted a greater future-orientation, as revealed by preferences for delayed but larger rewards.

Studies 5 and 6: Manipulated Density and Life Stage Specificity

Studies 3 and 4 find that two different experimental manipulations of density lead to a momentary shift toward greater future orientation, a common theme that underlies multiple aspects of a slow life history strategy. Given the range of behaviors that are influenced by population density at the nation and U.S. state level (Studies 1 and 2), in Studies 5 and 6 we broadened our scope to examine the effects of experimentally manipulated density on a range of behaviors, corresponding to three of the domains examined at the nation/state level.

The first domain is mating strategy. As outlined earlier, a slower life history is associated with a mating strategy inclined toward relatively higher investment in fewer relationships. This is represented, for example, in the nation-level analyses with higher population density being associated with a more restricted sociosexual orientation. A second domain of behavior is reproductive/parenting strategy, in which one considers the trade-offs between the quantity versus quality of offspring. A slower life history is associated with having fewer offspring but investing more in each. This is represented in both the nation-level and U.S. state-level analyses by higher densities predicting lower fertility and higher preschool enrollment. A third domain of behavior is investment in own embodied capital, in this case education. Slow life history strategists tend to invest more in embodied capital. This is represented in the U.S. state-level analyses with higher densities predicting more individuals with higher education.

One might hypothesize that individuals exposed to cues of increasing density will shift toward a slower strategy in all behavioral domains. However, this possibility does not take into account that these domains are differentially relevant across life stages (Neel, Kenrick, White, & Neuberg, 2016). A more plausible prediction is that density cues will influence life history strategy particularly in those domains *most relevant to an individual's life stage*.

In Studies 5 and 6, we examine this potential life stage specificity using a college sample (Study 5)—individuals at a life stage when mating goals are presumably more relevant than reproductive/parenting goals—and a relatively older MTurk sample (Study 6)—individuals at a life stage when reproductive/parenting goals are typically more relevant than mating goals. Specifically, we predict that college students will shift toward focusing investment in a few romantic relationships (a slower life history mating strategy) under perceptions of increasing density, but will not necessarily shift in their decisions about how many children to have (as they are not yet in the parenting life stage) or their educational investment (as they are already investing in it). On the other hand, we predict that the older MTurk sample, more likely to be in the parenting life stage, should shift toward preferring to have fewer children and investing more in each child (a slower life history parenting strategy) under perceptions of increasing density, but will not shift in their preferences regarding mating strategy or educational investment.

In both studies, we use experimental procedures similar to Study 3, having participants read an article describing increasing population density. A potential methodological issue highlighted earlier is that information of increasing population density may have simply triggered thinking about the future. Another potential issue is that, in Study 3, participants in the control condition did not read any article. Given the information heavy nature of the population density article, participants reading the article might have engaged greater executive function control, indirectly leading to longer-term thinking on the time orientation task. Thus, in Studies 5 and 6, we employed a different control condition, in which participants read an article similar to the density article in informational load, but instead describing an increasing density of squirrels.

Method

Participants. In Study 5, 311 individuals (176 females) participated as part of introductory psychology course requirements. The mean age of participants was 19.5 years ($SD = 2.9$).

For Study 6, we recruited participants from MTurk. Unlike Studies 3 and 4, we sought MTurk participants no more than 40 years old. This is because fertility begins to decline significantly after 40 years old, particularly for females (e.g., Eijkemans et al., 2014; Hassan & Killick, 2003), and reproductive decisions about numbers of children to have would typically already be made. However, given concerns about participants lying about their ages so that they would be eligible to participate, we chose not to specify any age eligibility criteria. Instead, using estimates from previous data sets on the proportion of MTurk participants who would fall in this age category, and with the aim of achieving an effective sample size comparable to Study 5, we recruited 500 participants, ending up with 506. Of these, 335 (175 females) were aged 40 and below, with a mean age of 29.2 years ($SD = 5.9$).

Procedure. For Study 5, college participants were brought into the lab in groups of three, and each participant was seated at an individual computer terminal. For Study 6, MTurk participants followed the same recruitment and set-up procedures as Study 3.

Participants were randomly assigned to either the control or density condition. Participants in the density condition read the article "The Crowded Life: Too Many, Too Much" from Study 3. In contrast to Study 3, however, in which control participants read no article, control participants in Studies 5 and 6 read an article titled "Squirrel Explosion: Too Many, Too Much," which described how the population of squirrels in the U.S. was growing at an unprecedented rate. It was formatted to be similar in content and style to the high density article. For example, as part of the article, participants read:

> A few months ago, Bob Buckley and his family made their way to a local park on a sunny spring day. When they got there, they were shocked to find the park overrun with squirrels. Within the limited space, Bob's family couldn't help running into the creatures. They attempted to play soccer in the field or find an open swing on the playground, but it was difficult to avoid them. When asked about how he felt, Bob responded, "I felt quite overwhelmed. There were so many of the critters. It seems like this is happening in other places too." . . .Throughout the United States, people are becoming increasingly familiar with a growing squirrel presence. According to statistics released by the National Parks Service this year, squirrel populations are growing at an unprecedented rate. In almost every U.S. state, populations have more than doubled in a space of 10 years. The population of ground squirrels in Flagstaff, Arizona, for example, was just over 8 million in 2000. Current estimates of the population are now over 20 million! And Arizona doesn't even have the fastest growing squirrel population. Colorado and California both have even higher growth rates . . .

After reading either the control or density article, participants then completed the life history behavior measures.

Life history behavior measures. To measure life history strategy in the different behavioral domains, participants were presented with three items designed to capture the differences in trade-offs between slow and fast life history strategies. Each question presented two options and participants were instructed to select which one they would prefer, and how strongly they would prefer it. Each question began with "Which of these two would you prefer?"

For the mating strategy measure, Option 1 was *Have one romantic/sexual partner and invest a lot in the relationship*, and Option 2 was *Have many romantic/sexual partners and invest less in each relationship*. Participants then indicated their preference on a 1 (*Definitely Option 1*) to 9 (*Definitely Option 2*) scale. Lower scores therefore indicate a slower life history mating strategy.[6]

The reproductive/parenting strategy measure was similarly formatted, with Option 1 being *Have one child and invest all your time and resources into that one child*, and Option 2 being *Have multiple children and split your time and resources across all of them*. Again, lower scores on this measure indicate a slower life history parenting strategy.

Finally, for the educational investment measure, Option 1 was *Work on a job that pays you now*, and Option 2 was *Spend time/money to learn new skills (e.g., education) now, but get a job that pays more in the future*. This measure was reverse-scored such that lower scores would indicate a slower life history strategy (like the other two measures) of investing in embodied capital. The presentation order of the three measures was randomized for each participant.

Results and Discussion

For Study 5, we first conducted a Condition (Control/Density Article) × Life History Domain (Mating/Parenting/Education) mixed ANOVA. There were main effects of both Condition, $F(1, 307) = 5.23$, $p = .023$, $\eta_p^2 = .017$, and Life History Domain, $F(2, 614) = 143.62$, $p < .001$, $\eta_p^2 = .32$. As expected, this was qualified by a significant interaction, $F(2, 614) = 3.77$, $p = .024$, $\eta_p^2 = .012$. Given our specific predictions, we examined the simple effects of the density manipulation within each life history domain. Tracking predictions, college participants in the density condition shifted toward a preference for fewer, high investment, relationships, relative to participants in the control condition, $F(1, 307) = 10.24$, $p = .002$, $\eta_p^2 = .032$. In contrast, there was no significant effect of experimental condition on reproductive/parenting strategy [$F(1, 307) = 1.27$, $p = .26$, $\eta_p^2 = .004$] or educational investment [$F(1, 307) = .88$, $p = .35$, $\eta_p^2 = .003$] (see Figure 4).

For a similar analysis with the MTurk participants (Study 6), there was a marginal main effect of Condition, $F(1, 333) = 2.74$, $p = .099$, $\eta_p^2 = .008$, and an effect of Life History Domain, $F(2, 666) = 64.69$, $p < .001$, $\eta_p^2 = .16$. There was however no significant interaction effect, $F(2, 666) = 1.80$, $p = .17$, $\eta_p^2 = .005$. Nonetheless, given our specific predictions, we examined the simple effects of the density manipulation within each life history domain. As expected, the young adult participants in the density condition shifted toward a preference for fewer children, with higher investment in each child, $F(1, 333) = 4.33$, $p = .038$, $\eta_p^2 = .013$. There was no significant effect of experimental condition on mating strategy [$F(1, 333) = .74$, $p = .39$, $\eta_p^2 = .002$] or educational investment [$F(1, 333) = .18$, $p = .67$, $\eta_p^2 = .001$] (see Figure 5).[7] However, our conclusions must remain tentative with respect to the life stage specificity effect for the MTurk sample, given that the full interaction test was not statistically significant.

To summarize, using a different control condition and a broader range of measures, individuals given information of increasing population density again seemed to shift toward a slower life history strategy, but particularly so for behaviors relevant to their current life stage. Specifically, college students cued with increasing density preferred fewer, high investment, relationships, but did not exhibit changes in their potential reproduction/parenting strategy or educational investment. On the other hand, relatively older individuals cued with increasing density preferred to have fewer children and to invest more in each child.

[6] Reviewers raised the possibility of sex or relationship status influencing the current experimental effects, given existing work on sex differences in mating strategies. Additional analyses were conducted with participant sex and relationship status as factors, but in neither study were there significant interactions of either factor with the experimental manipulation. Hence, we do not present these analyses here.

[7] We conducted additional exploratory analyses for the MTurk sample, first examining the effects of the experimental manipulation on the participants who were older than 40. There was no effect of the manipulation on any of the three life history behavior measures (all $ts < .54$, $ps > .59$). We then examined the manipulation effects on relatively young MTurk participants, to assess whether there would be a similar pattern of findings as what we found in the college student sample in Study 5. We selected a cutoff age of 22 years and younger (to create an age range comparable to college students), which left a sample of 46 MTurk participants. With this small sample size, we did not expect significant effects. Nonetheless, the pattern of findings with the college-aged MTurk participants appeared to replicate the pattern observed with the Study 5 college sample: There was a trend for individuals in the density condition to prefer fewer, high investment, relationships [$t(44) = 1.60$, $p = .12$], and seemingly no effect on parenting strategy [$t(44) = .38$, $p = .71$] or educational investment [$t(44) = 1.09$, $p = .28$].

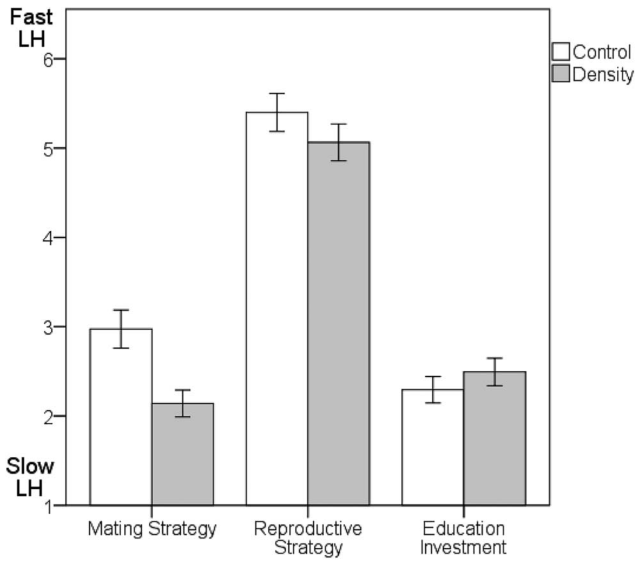

Figure 4. Density manipulation effects on life history variables in Study 5 (college sample). Lower scores mean slower life history strategy. Error bars represent ± 1 *SE*.

General Discussion

We began with the question of how population density might influence behavior in modern societies. Across six studies, we find that high densities are associated with a host of traits corresponding to a slower life history strategy. Across nations (Study 1) and the U.S. states (Study 2), populations with higher densities exhibit a greater future orientation, higher investment in embodied capital (i.e., higher education), greater preference for long-term mating relationships, later marriage age, later age of reproduction, lower fertility, and higher parental investment as indexed by the enrollment of children in preschool. These relationships generally held controlling for economic development, urbanization, and population size. Then, in two experimental studies (Studies 3 and 4), using different manipulations of density, individuals for whom high densities were cued also showed a shift toward a greater future orientation. Finally, in two additional experiments, individuals seemed to react to density differently depending on their current life stage. Specifically, individuals in a typical mating life stage shifted toward a slower mating strategy under perceptions of increasing density—preferring fewer relationship partners and investing more in each relationship (Study 5). In comparison, individuals in a typical parenting life stage shifted toward a slower reproductive/parenting strategy under perceptions of increasing density—preferring to have fewer children and investing more in each child (Study 6).

Our general prediction that high densities would lead to a slower life history strategy is derived from life history theory. Individuals in a densely populated ecology likely experience high levels of social competition, in response to which a slow life history strategy may be more adaptive, allowing the building of both individual and offspring competitiveness. As far as we are aware, this is the first test of this general hypothesis in modern societies, at different levels of analysis, using both correlational and experimental methods, and across a diverse range of behaviors. Reexamining an old topic from a previously unutilized perspective has shed new light on density's psychological impact.

Life History Strategies as Suites of Behaviors

For the nation and state-level analyses, we examined life history theory's predictions across a range of behaviors—finding, for example, that higher density predicts both greater investment in education and fewer children per female. Given that highly educated women tend to have fewer children (e.g., Shenk, Towner, Kress, & Alam, 2013), one might wonder whether educational investment is an alternative explanation for density's effects on the other life history variables, such as fertility, or marriage age.

Our answer is, not necessarily. Life history theory proposes that fast and slow life history strategies comprise suites of behaviors that often come together. Consider, for example, the two forms of genetically identical male salmon, the hooknose and jack. As mentioned in the introduction, whether an individual salmon becomes a hooknose or jack depends on the environment (Gross, 1991). The hooknose emerges in low predator ecologies and waits longer before reproducing, instead building its body size and enhancing its ability to compete directly with other males for access to females. Delayed reproduction, investment in body size, and direct competition all work together as part of the hooknose's slower life history strategy. In contrast, the jack emerges in high-predator ecologies; given its anticipated shorter life span, it allocates its energy toward reaching sexually maturity quickly, thereby trading off size and competitiveness and adopting instead an opportunistic mating strategy. Again, investment in early reproduction, small body size, and sneak copulation, work together as components of the jack's fast life history strategy. To view body size as an alternative explanation for the effects of predator pressures on salmon mating strategies would be theoretically incomplete, because variations in body size itself needs to be explained.

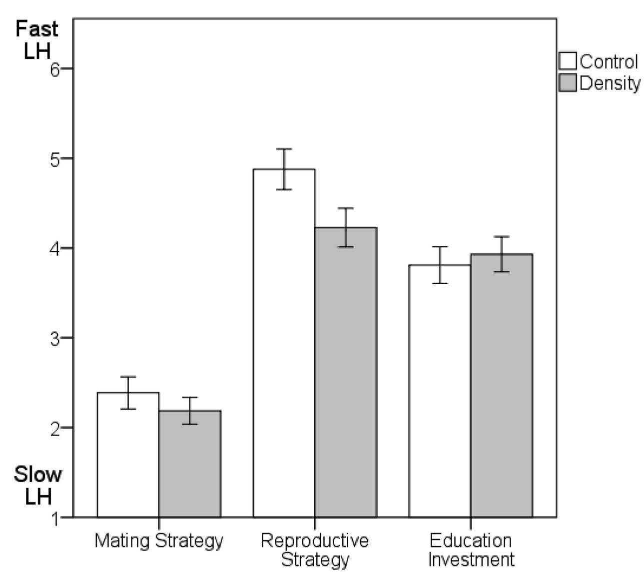

Figure 5. Density manipulation effects on life history variables in Study 6 (MTurk sample). Lower scores mean slower life history strategy. Error bars represent ± 1 *SE*.

And like mating strategy, body size variation is likely a part of the same suite of (life history) responses to predator pressure.

Similarly, to view educational investment as an alternative explanation for the effects of density on marriage age or number of offspring is also incomplete, because educational investment itself needs to be explained. And from a life history perspective, educational investment, marriage age, and offspring number may all be considered part of the same suite of life history responses to population density. This is not to say that how much a society values education (and similar skill-based investments), and the relevant opportunities available to a population, may not be independent factors driving some of the current observed effects (see Kaplan, 1996; Low, Simon, & Anderson, 2002). Even so, to the extent that available skill investment opportunities are at least in part driven by social demands for such opportunities, the social demands may themselves be an outcome of increasing densities (which lead to increasing competition and a desire for more ways to build skills). Teasing apart the multiple processes at play here will be useful in future work.

Density and Fast Strategies?

Intuitively, dense environments might seem to be associated with faster life history behaviors (or general social pathology), especially when resources are scarce; consider, for example, people's stereotypes of behaviors seen in impoverished and densely populated city areas. As highlighted earlier, however, reviews of findings do not support these intuitions (Freedman, 1979; Lawrence, 1974).

Moreover, from a life history perspective, it is not clear why increases in density would lead to faster strategies when resources are scarce. To crudely illustrate, imagine two ecologies of equal physical space, one having 10 resource units (low resource) and the other having 100 resource units (high resource). Imagine also that each of these two ecologies can have 100 people in it (low density), or 1000 (high density). Consider, first, the high resource ecology with 100 resource units. With low density, there is 1 resource unit for each person (100 resources/100 persons), whereas with high density, 10 persons need to compete for each resource unit (100 resources/1000 persons).[8] Higher density leads to increased social competition, which should elicit a slow life history strategy. Consider, now, the *low* resource ecology with only 10 resource units. With low density, 10 persons need to compete for each resource unit (10 resources/100 persons), whereas with high density, 100 persons need to compete for each resource unit (10 resources/1000 persons). High density, again, leads to increased social competition. Regardless of whether an ecology holds many resources or few, increasing density still leads to increasing social competition, and presumably, to a slower strategy needed to successfully compete. Hence, as conceptually outlined here, we do not make strong predictions about density interacting with resource levels to predict fast versus slow behaviors.

Indeed, using GDP per capita as a proxy for resource levels at the nation (Study 1) and at the U.S. state level (Study 2), and self-reported socioeconomic status as a resource measure for Studies 3 and 4, we find no evidence that higher densities lead to faster strategies at low resource levels (see supplemental material). In fact, higher densities still lead to slower strategies at low resource levels.

This is not to say that fast life history strategies cannot emerge in high density ecologies. For example, when population density is accompanied by access to lethal and unpredictable means of competition (e.g., guns)—the modern human equivalent of being in an ecology with high predation pressure—the logic of life history theory would predict that individuals in this ecology would adopt a faster strategy. Moreover, to the extent that high density leads to an increased prevalence of highly infectious and lethal diseases, one would also predict that the population would engage a faster life history strategy.

Fast life history strategies could also emerge within high density ecologies for another reason, related to different forms of social competition. *Contest* competition occurs when individuals do not have equal access to resources for survival and reproduction, because of interference by others (e.g., aggression, territoriality, status hierarchies). Human competition is predominantly characterized by contest competition (e.g., Ellis et al., 2009; Puts, 2010), which selects for the building of abilities and skills that facilitate successful contests, or a slow strategy of building embodied capital. In contrast, in *scramble* competition all conspecifics have similar access to resources, and this leads to a fast strategy characterized by short-term oriented and opportunistic attempts to consume resources before they are used up by others. Although contest competition is more typical for our species, there may be situations where scramble competition is the mode. In such situations, higher densities may lead to more opportunistic behaviors and traits corresponding to a faster life history strategy.

Thus, although we do not find that higher density leads to a faster life history strategy, we do not suggest that this never happens. Indeed, one might speculate that density encourages faster strategies in ecologies characterized by unpredictable death and disease, or forms of scramble competition. These possibilities remain to be explored.

Mechanisms

Across six studies, we find a consistent association between higher densities and traits representing a slower life history strategy. Although the experimental studies demonstrate a causal relationship, it is not yet clear what mechanisms underlie these effects. What is likely, however, is that such mechanisms operate at multiple levels—evolutionary, cultural, developmental, and sociocognitive—and thus should generally be viewed as complementary rather than as competing.

As presented in the Introduction, one possibility is evolved phenotypic plasticity (Pigliucci, 2005; Stearns, 1989; West-Eberhard, 1989). Given that organisms have faced different ecologies in their ancestral history, and different behaviors vary in adaptiveness depending on ecological circumstances, evolution would have selected for flexible mechanisms that alter an organism's traits and behaviors according to the current ecology. One might think of such flexibilities as "if–then" strategies (Neuberg,

[8] One might argue that, if the energy needed for each individual to survive is minimal, there may be no need to compete for resources regardless of social density. However, from a life history perspective, any excess energy would be utilized for reproduction. Hence, higher social densities would still generate greater competition for reproduction-relevant resources.

Kenrick, & Schaller, 2010). In the case of density, the flexibility might be represented as: *if* density is high, *then* adopt a slower life history strategy. When such environmental contingencies express themselves as psychological differences across cultures, as may be the case in our nation- and state-level data, this is also referred to as "evoked culture" (Gangestad, Haselton, & Buss, 2006; Schaller & Murray, 2008; Tooby & Cosmides, 1992).

A plasticity interpretation suggests multiple potential psychological mechanisms. For instance, individuals exposed to high densities during childhood may come to adopt slower life history traits, such as a later sexual maturation, and engage in early efforts toward building embodied capital. Such developmental effects might be mediated by pathways involving changes in hormonal profiles or brain development. Although developmental mechanisms cannot alone account for the experimental findings, they could nonetheless help drive the observed effects at the nation and state level.

The experimental findings suggest the action of motivated cognitive processes. For example, perceptions of increasing density could lead to expectations of more competitive behaviors from others, perceptions of increased difficulty of obtaining resources, perceptions of increased difficulty in finding and retaining mates, or even perceptions of oneself as having poorer abilities, which could in turn motivate resource investment in increasing embodied capital. Indeed, given the life stage specificity findings of Studies 5 and 6, the key cognitive processes driving a slower life history strategy might vary depending on an individual's current life stage. Situational density could also exert its effects through less conscious processes or affective reactions. None of these are mutually exclusive, and could each be occurring independently.

It is important to note the limits of plasticity. Although the experimental findings might suggest a relatively high degree of flexibility, indefinite flexibility should not be expected. This is because there are costs to flexibility itself (see DeWitt, Sih, & Wilson, 1998, for a review). Plasticity requires additional energy to maintain sensory mechanisms for gathering ecological information. Ecological information can also be imprecise, leading to phenotypic changes that are unnecessary or even maladaptive. Hence, developmental canalization, or the irreversible calibration of life history traits depending on developmental ecologies, could be useful and is likely to emerge under some circumstances—as per the hooknose and jack salmon example earlier, and, more directly relevant, the earlier sexual maturity reached by individuals living in unpredictable environments. Given the effects of the current experimental manipulations on the life history relevant traits examined here (e.g., time orientation, mating strategy), these traits presumably have some degree of freedom from canalization. Even so, we do not presume that these manipulations do anything more than momentarily update information about the current ecology, thereby exerting only short-lived effects should this new information be unsubstantiated over time (e.g., by chronic exposure to density cues).

The slow life history strategies observed in dense populations may also be shaped in part by cultural transmission and self-selection processes (Boyd & Richerson, 1985; Schaller, Conway, & Tanchuk, 2002). For example, densely populated areas like Singapore may have strong educational systems, and injunctive norms against early and promiscuous sex. The descriptive norms of such societies might also encourage slow strategies. In addition, people often have a choice in where they live and tend to choose places that match their personality and outlook, as well as afford them opportunities to pursue their goals. Just as people who are more individualist and more prone to novelty-seeking may be attracted to frontiers (Kitayama, Varnum, & Sevincer, 2014; Varnum & Kitayama, 2011), so too might people with slower life history strategies be attracted to places with higher densities.

The processes above are not mutually exclusive, and there may be considerable differences in the processes (or combinations of processes) involved, depending on the level of analysis. Pertinent to this are recent discussions in the behavioral immune system literature regarding how one might conceptualize the relationship between pathogen prevalence and in-group preferences, and the complexities involved in testing such hypotheses across multiple levels of analysis (e.g., Hruschka & Hackman, 2014; Pollet, Tybur, Frankenhuis, & Rickard, 2014). Although it may be cognitively parsimonious to assume that the relationship between density and life history strategy at the different levels of analysis is driven by a single mechanism, we caution against doing so. Our guess is that the reality is likely to be far more complex.

Time Perspective and Life History Strategy

Throughout the current work, we have discussed future orientation—engaging in behaviors and forms of investments for which benefits can only be reaped in the future—as a theme underlying a slow life history strategy. This is similar to existing concepts in work on time perspective (e.g., consideration of future consequences: Strathman, Gleicher, Boninger, & Edwards, 1994; delay of gratification: Mischel, Shoda, & Rodriguez, 1989).

The current work expands that literature by highlighting a potential ecological factor that may underlie meaningful variation between groups on time perspective. That the social density of the environments individuals live in might influence their time perspectives is a unique prediction that derives from a life history framework. In addition, life history theory also draws links between time perspective and a wide range of behaviors that would not otherwise seem related (e.g., investment in children, mating strategies), and connects existing social psychological literature with work in nonhuman animal behavior. Finally, in light of the life stage specificity findings of Studies 5 and 6, one potentially interesting implication is that an individual's time perspective, to the extent that it is indeed influenced by his or her life history strategy, might manifest most prominently in behaviors particular to his or her current life stage.

From Ecology to Cultural Psychological Variation

The importance of ecology for understanding psychological variation between populations has been highlighted by recent highly productive applications of ecological thinking. For instance, high pathogen loads seem to lead to lower extraversion and openness (Schaller & Murray, 2008), more complex and ambiguous environments encourage more contextual attention styles (Miyamoto, Nisbett, & Masuda, 2006), and ecologies with high social mobility appear to foster independent selves (Oishi, 2010). Other work has examined the influence of subsistence activities, as constrained by ecologies, on cognitive styles. Populations that engage in subsistence activities requiring more social cooperation and interdependence (e.g., farming as opposed to herding) tend to be more holistic in their cognitive styles, perceiving objects in their environment to be related to one another (Uskul, Kitayama, & Nisbett, 2008). Even finer predictions have recently been made within subsistence styles, with types of farming that differ in social cooperation (e.g., rice as opposed to wheat) exerting different effects on cognition (Talhelm et al., 2014). Ecological thinking has also been utilized to examine cultural change across time (Grossmann & Varnum, 2015), with increases in socioeconomic status and urbanization, and decreases in pathogen prevalence, preceding a rise in individualism. Finally, recent work has also turned ecological perspectives on their head, demonstrating that if people's behaviors are indeed influenced by ecological circumstances, then social perceivers would hold ecological *stereotypes*—beliefs about how people who live in different environments are like (Williams, Sng, & Neuberg, 2016).

The above findings suggest, generally, that cultural norms and practices might emerge as a direct outcome of local ecological pressures. It may also be the case that certain cultural practices emerge as a *counterweight* to ecologically driven psychologies and behaviors that pose challenges to effective group living. Such a possibility is suggested by our findings that cultural tightness (Gelfand et al., 2011) may be associated with individual inclinations toward a fast life history strategy (e.g., higher fertility at the nation level; higher teenage birth rates at the U.S. state level). In other words, there may be an interesting balancing dynamic between ecologically triggered behaviors and societal norms, with cultural tightness emerging to keep fast strategy individuals in check. Given the tentative status of our findings regarding tightness–looseness, however, such speculations should be viewed as preliminary. We also reiterate that the relationship between tightness–looseness and life history strategy can be orthogonal; societies, for example, could have tight norms to reinforce either slow (e.g., rules about maximum fertility) or fast strategies (e.g., rules about minimum fertility) among their members. The relationship between life history strategies and societal tightness–looseness is an interesting area for future work.

In Closing

Beyond their theoretical importance, our findings may hold important societal implications. As populations worldwide continue to grow, density continues to increase. One might thus predict, all else equal, a global trend toward slower life history strategies. The issues that accompany such a trend have already surfaced. Several countries are now grappling with problems associated with below-replacement fertility rates (e.g., Japan, Singapore); as people move toward delaying reproduction and having fewer children, labor forces shrink and populations are rapidly aging (Brooks, 2012). Developing an understanding of how social density influences our psychology will be relevant for tackling these issues.

Life history theory is a general theory about resource allocation, and different behaviors might be broadly conceived as different ways of allocating resources. From this perspective, then, there exist many unexplored psychological variables that density may influence, including those related to friendships, emotions, and social cooperation. A useful general heuristic might be that higher densities are likely to lead people toward a greater focus on "quality rather than quantity," in multiple types of time and energy investment. This focus is facilitated by a future-oriented time perspective, which itself has implications for a variety of behaviors. Much remains to be examined. We hope this initial foray will generate renewed interest in a topic that has been all but forgotten, and encourage the field of research on density to become a little more crowded.

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