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Life History Speed Mediates the Relationship between Environmental Conditions, Health-Related Behaviors, and Self-Reported Health

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ABSTRACT

Life history theory (LHT) is a powerful explanatory framework in evolutionary science, integrating evolutionary, ecological, and socio-developmental perspectives. This study tests a life history framework for understanding variation in health-related behaviors in a modern society. Several life history indicators, including the Mini-K, Consideration for Future Consequences, and environmental Resource Stability were tested as mediations of the influences of neighborhood conditions, both developmental and current, on tendencies for health promoting and health adverse behaviors. Both Consideration for Future Consequences and Resource Stability mediated the relationship between neighborhood conditions and self-reported health and patterns of health behaviors. However, scores on the Mini-K did not mediate these relationships. The results of the current study suggest that progress in understanding and improving human health may be accelerated greatly by integrating insights from life history theory. Many human health challenges are related to trade-offs between immediate and long-term rewards. Interventions to promote healthy behavioral patterns will benefit from efforts to improve direct environmental affordances as well as long-term environmental stability.

KEYWORDS

Life History, Health Behavior, Health, Neighborhood Environment, Time Perspective, Plasticity

Technological and policy advances in medicine, pharmacology, public health, and sanitation have dramatically improved human health and longevity in technologically advanced societies (National Institute on Aging, 2011). People living

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in developed nations today have life expectancies exceeding 80 years. In comparison, most people born in the year 1900 did not live past 50 years, and had generally worse health conditions than those living today (National Institute on Aging, 2011). Despite these improvements in health and longevity, there has also been an epidemiological transition where the major sources of mortality have shifted from infectious diseases, parasites, and accidents to late onset diseases such as hypertension, type 2 diabetes, and cancer. These diseases resulting from so called "lifestyle causes" are the largest challenge in modern populations and are notable for their substantial behavioral components (National Institute on Aging, 2011).

Technological advances continue to extend abilities to save lives in immediate medical crises. However, life expectancies in the United States plateaued in 2014 and have been declining since then (Woolf & Schoomaker, 2019). The increase in mortality rates and decline in life expectancy is due to both risky behaviors such as drug overdoses (largely from opioids), alcohol abuse, and suicides, as well as diseases of organ systems which are influenced by long-term behavioral patterns (Woolf & Schoomaker, 2019). This pattern demonstrates the need for the enhancement of the theoretical frameworks that currently inform health behavior research, health education and health promotion interventions.

The Impact of Health-Related Behavior

Health-adverse behaviors such as smoking, excessive alcohol use, unhealthy diets, risky sexual activity, and sedentary lifestyle are costly in both health and financial terms to individuals, families, and society (Sculpher, 2001). Treating obesity may account for 20% of health-related spending ($344 billion per year) in the United States (Thorpe, 2009), and yet the prevalence of obesity, and especially severe obesity, continues to increase (Finkelstein et al., 2012). It is known that engaging in health-adverse behaviors and neglecting health-promoting behaviors (such as exercise) has long-term impact on overall health and mortality (Behrens et al., 2013; Booth, Roberts, & Laye, 2012; McCullough et al., 2011). Those who smoke tobacco live an average of 6.5 years less than non-smokers due to each cigarette smoked reduces a person's life by approximately 11 minutes (Behrens et al., 2013). Smoking tobacco can create a cascade of negative health effects and can lead to other chronic health conditions such as heart attacks, stroke, and many different types of cancer (Jha et al., 2013), costing $96.8 billion in lost productivity and 480,000 lives each year in the United States alone (Maciosek et al., 2015).

Another behavioral factor that reduces overall health is heavy or excessive alcohol use, which can cause damage such as liver cirrhosis (damage to liver cells), pancreatitis (inflammation of the pancreas) and various cancers (Johnson et al., 2014), shortening lifespans by an average of 30 years (Johnson et al., 2014; Sacks et al., 2015). The excessive use of alcohol can also lead to a variety of social issues such as absenteeism from work, losing jobs, family problems, and mood swings (Brick, 2012). This health behavior is very costly not only in dollars, but also the loss of human life. In the United States heavy alcohol use and its associated issues have cost nearly $250 billion dollars in 2010 (Sacks et al., 2015), and has led to 88,000 deaths per year (Bouchery et al., 2011).

Furthermore, consuming an unhealthy diet can lead to poor health, obesity, hypertension, and type 2 diabetes (Bauer et al., 2014). Similar effects to consuming an unhealthy diet can be seen in individuals that lack of regular exercise (Bastien et al., 2014). These chronic diseases in turn result in early mortality and a reduced quality of life (Wilmot et al., 2012). Beyond economic costs and personal health, poor health behaviors have adverse effects on families (Taylor et al., 1997), including a detrimental financial impact (Zhang et al., 2011). Along with the financial impact, some of these behaviors are known to effect children's current and future health. For example, those who smoke tobacco can create breathing related issues for family members, especially children, including asthma, bronchitis, and chronic obstructive pulmonary disease (Morrison et al., 2012). Children of parents who smoke tobacco are also more likely themselves to smoke tobacco as they age (Schuck et al., 2012). Parents who consume unhealthy diets can lead a whole family to eat unhealthily and result in obesity and long-term effects on food preferences in their children (Larsen et al., 2015).

Advancing the Understanding of Health-Related Behavior with Life History Theory

Health educators and public health specialists use theories and models as frameworks for needs assessments, program design, and program evaluation. As health educators continue to focus on improving the quality of life and overall health of those living in the United States and around the world, new theories and models should be developed and evaluated to determine their usefulness. Adding new and valid theories and models to the "toolboxes" of health educators provides them with increased odds of designing successful interventions. Current health behavior theories and models do not typically address individual and personality differences related to health behavior tendencies and motivations. These models typically assume that if people only had the relevant information and opportunity, they would consistently make health-promoting choices (Bentley & Aunger, 2008; Kruger, 2011). Life History Theory may be particularly valuable in promoting understanding of variation in health-related behaviors (Kruger, 2011).

Life History Theory (LHT) is central to modern evolutionary biology and is being increasingly integrated into models of and research on human psychology and behavior. This theory provides great insight into how our evolved genetic heritage, our developmental, and current environments shape fundamental aspects of human motivation and cognition. Evolutionary biologists have long recognized that organisms must make trade-offs in resource allocations because their capacities to invest and allocate resources are shaped by environmental conditions (Fisher, 1930). For example, a person who lives in a resource scarce environment may choose to invest resources for short term gains, verses long term savings, which they may not be around to enjoy. When organisms cannot predict important conditions such as the availability of resources and death from predation, they tend to accelerate growth and reproduction to take advantage of transient opportunities (Weinrich, 1977).

LHT was originally developed to explain differences across species; however, it has great potential for promoting understanding of human variation and issues related to human health. People living in chronically uncertain environments are more

likely to experience earlier menarche, earlier ages of reproduction, higher reproductive rates, lower birthweights, shorter breastfeeding, lower paternal investment, less alloparenting support from extended family members, and higher levels of violence (Chisholm, 1999; Copping & Campbell, 2015; Copping et al., 2013; Kim et al., 1997; Nettle, 2010). All of these consequences that are trigged by environment cues have consequences for human health and reproduction, and can have a ripple effect for generations.

US inner-city middle school students who had more supportive socio-developmental environments (in terms of perceptions of physical safety, positive socialization, and the helpfulness of others) had greater future-orientation and lower orientation towards immediate rewards. These time perspectives predicted lower levels of interpersonal aggression and property crimes (Kruger, et al., 2008). US community college students who had higher estimates of future unpredictability and lower expectations for their lifespan had a higher frequency of risk-taking (Hill et al., 1997). Furthermore, neighborhood life expectancy and neighborhood income inequality predicted homicide rates in Chicago. Wilson and Daly (1997) argued that this pattern was the result of steep future discounting in environments, where the probability of receiving delayed benefits is uncertain or low and the expected benefits of safer courses of action are negligible.

The Importance of Time Perspectives

Individuals' time perspectives (variously defined and measured as time horizons, future discounting, planning, etc.) may be an important psychological representation of life history tradeoffs. Future orientation (low future discounting, etc.) reflects a pattern of behavior dominated by a striving for future goals and rewards. Short time horizons, substantial future discounting, and tendencies for risky behaviors related to accelerated life histories contribute to a wide variety of health issues, concerns, and outcomes. The future-oriented health behaviors encouraged by health promotion efforts depend on environmental conditions that are relatively stable over time. Those who grow up in less predictable environments are less likely to be future oriented in their behaviors, because of the low probability of reproductive success for more cautious and longer-term approaches across human evolutionary history. Instead, these individuals will develop more immediate outcome oriented and relatively riskier behavioral patterns (Hill et al., 1997; Wilson & Daly, 1997).

Some psychologists have long recognized that people view time differently depending on the environment in which they live (Lewin, 1942), though the importance of this pervasive and powerful influence may be under-recognized (Zimbardo & Boyd, 1999). Mischel and colleagues (1989) have demonstrated relationships between future-oriented self-control and important life outcomes such as social competence, educational achievement, and resilience to frustration and stress. Time orientation is an important predictor in alcohol, drug, and tobacco use among adults (Keough et al., 1999) and an LHT-based model incorporating time perspective may explain and predict substance use behaviors better than conventional models (Richardson & Hardesty, 2012).

However, the theories and models prevalent in health education and research on health behaviors (e.g. Health Belief Model, Theory of Planned Behavior) do not

take time perspective or environmental predictability into account. Unpredictable environments, where personal safety, social support, and access to important resources are not reliably available may foster tendencies to discount future health in favor of immediate rewards. Previous studies have suggested the value of incorporating LHT and time perspective into models of health-related behaviors (e.g., Richardson & Hardesty, 2012). For example, adults across the US with lower socio-economic status perceived higher extrinsic mortality risk, which in turn predicted the level of effort invested in health and safety (Pepper & Nettle, 2014). Furthermore, adults with slower life history speeds participating in a demographically representative community health survey had higher levels of health promoting behaviors, exercise and consumption of fruits and vegetables, and lower levels of health adverse behaviors: smoking tobacco, alcohol consumption, binge alcohol consumption, and behaviors that create high risk for HIV infection (Kruger & Kruger, 2016). These relationships were significant even when controlling for life history related socio-demographic factors, such as age, gender and educational attainment.

Current Study

The central hypothesis of this project is that a life history framework can advance the understanding of human health patterns by integrating environmental influences, individual variation in psychological traits, and variation in health-related behaviors. This study builds statistical models to test this hypothesis. The current study builds on previous work integrating life history theory into the understanding of health-related behaviors in several ways. First, it includes the most common measure currently used to assess life history speed (Mini-K; Figueredo et al., 2006), along with an extensively validated measure of time perspective (Consideration for Future Consequences; Strathman, et al., 1994), and a measure of the predictability of important resources (Resource Stability; Kruger, 2018) as convergent predictors of life history variation. Scores on the Mini-K are associated with variation in a wide range of health-related behaviors (Kruger & Kruger, 2016); however, this measure has received substantial criticism (e.g., Copping et al., 2014) for combining a broad range of constructs varying in content and timeframe. Multi-item measures with disparate content suffer from conceptual complexity, which hinders the representational accuracy necessary to clearly answer empirical questions (Cohen et al., 1999; McGrath, 2005). In other words, because so many different things are measured in combination, one does not know which aspects are responsible for statistical relationships. The Mini-K includes one item on future planning, as well as other constructs such as childhood parental relationships and contemporary social support.

Assessing time perspectives with Consideration for Future Consequences (Strathman, et al., 1994) enables an empirical comparison with a clearly defined construct. As described above, individuals' time orientations are central to the psychological representation of life history trade-offs (Chisholm, 1999; Wilson & Daly, 1997). The measure of Resource Stability (Kruger, 2018) assesses life history variation in a complementary way, based on the predictability of important environmental resources which is central to classic life history theory (e.g., MacArthur & Wilson, 1967; Pianka, 1970). People living in less predictable environments employ

behavioral strategies more oriented towards immediate outcomes, and with greater variation in success, to take advantage of transient opportunities (Chisholm, 1999; Frankenhuis et al., 2016; Wilson & Daly, 1997).

Second, the study advances beyond previous life history models by incorporating extensively validated measures of neighborhood environments (Social Capital; Sampson et al., 1997; Neighborhood Safety; Smith et al., 1999). Neighborhood conditions predicted tendencies for violent behaviors and property crimes in US inner-city middle school students, as mediated by time perspectives (Kruger et al. 2008). Compared to those in affluent English neighborhoods, those in deprived neighborhoods had earlier ages of first birth, lower birth weights, more father absence, and less alloparenting from grandparents (Nettle, 2010). Life history variation is expected to mediate, at least partially, the relationship between neighborhood conditions and health behaviors.

Third, the study includes assessments of both developmental and current neighborhood environments. Most conceptual frameworks founded on life history theory propose developmental sensitive periods early in the lifespan (e.g., middle childhood; Belsky et al, 1991) that shape variation in physiology and behavior for the remainder of the lifespan (Frankenhuis & Fraley, 2017). Mathematical models suggest that extended life history plasticity would be beneficial because the predictive power of environmental experiences decreases more and more rapidly over time (Nettle et al., 2013). Empirical studies suggest that experiences later in life, even in adulthood, may influence life history strategies (Fraley & Heffernan, 2013; Van Gelder et al., 2013; Van Gelder et al., 2015; Kruger, 2018).

METHOD

Participants

The University of Toledo Social Behavioral & Educational Institutional Review Board approved the study design and protocol prior to data collection. Participants in an on-line Qualtrics survey were recruited through Amazon's Mechanical Turk (MTurk). MTurk settings were selected to only include those who were 18-75 years old and resided in the United States. Best practices in on-line survey research methods were used to maximize the response rate and data usability. To ensure that the sample only included residents of the United States, the researchers added three questions at the beginning of the survey to confirm location of residence. If MTurk users answered these questions inappropriately, they were directed to the end of the survey and did not receive payment. Incentive payments of $0.50 USD were distributed automatically through the MTurk system upon completion of the survey. This amount was considered to be a sufficient amount for the data collected (Chmielewski & Kucker, 2019). An a priori power analysis was conducted to (a) determine the necessary sample size, and (b) minimize Type II error (Price, 2005). With alpha level set at .05, effect size set at .20, with a two tailed test, and desired power at .90, with a 5% margin error, the sample size calculations indicated that at least 450 completed surveys were needed.

Participants (*N* = 820) were 56% women and 44% men, with a mean age of 38 years (*SD* = 13, range 18-75). Educational attainment was 10% High School or less, 23% Some college, 13% Associates, 36% Bachelors, 14% Masters, and 4% Doctorate. Races were 78% Caucasian, 10% African American, 10% Asian, and 2% American Indian or Alaskan Native. Geographical analysis of participants' ZIP Codes indicated that participants were from all 50 US states, Washington, DC, and Puerto Rico. California, the most populous state, had the greatest representation (*n* = 71; 9.5% of the sample). Alaska, Maine, Montana, North Dakota, Puerto Rico, and Wyoming each had one participant. The median state had 10 participants (1.3% of the sample).

Assessments and Measures

The survey instrument was reviewed and pilot tested to establish its validity, readability, acceptability, and reliability. To establish face validity, the investigators completed a comprehensive review of the published literature on Life History Theory, conscientiousness, time perspective, and factors that relate to health behavior change. To establish content validity, the survey instrument was sent to a panel of experts (*n* = 4) recognized by their publishing records, in the fields of evolutionary psychology, survey research, health education, and/or behavioral science. Recommended revisions from this panel were incorporated in the survey instrument prior to its use with the pilot test group. The revised survey instrument was administered to a pilot test group consisting of a convenience sample of local adults (*n* = 25). The stability-reliability of the survey was established by administering the survey twice within a 10-day period to the pilot test group. The matched pairs of surveys were analyzed using Pearson correlation to determine the consistency of responses from time "A" to time "B." All scales demonstrated at least a .60 Pearson Correlation coefficient, test-retest correlations ranged from .698 to .894. Internal reliability of the subscales was high, with Cronbach's alpha ranging from .86 to .90. A Flesch-Kincaid readability analysis determined that the survey was at the eighth grade (8.0) readability level. A Simple Measure of Gobbledygook (SMOG) test revealed a reading level of grade 8.2.

Measures of environmental conditions included Developmental Neighborhood Social Capital (DNSC; adapted from Sampson et al., 1997); Developmental Neighborhood Safety (DNS; adapted from Smith et al., 1999); Current Neighborhood Social Capital (CNSC); and Current Neighborhood Safety (CNS). DNSC is a 4-item, 5-point response scale with responses ranging from "Strongly agree" to "Strongly disagree." The question stem read "Please think about the neighborhood you spent the most time in when you grew up, please tell us how much you agree or disagree with the following statements." Items include: "People were willing to help their neighbors."; "People could be trusted."; and "There were adults that children could look up to." CNSC has parallel items framed in the present tense (e.g., "People are willing to help their neighbors."). The question stem read "Please think about the neighborhood where you live now, please tell us how much you agree or disagree with the following statements." DNS is a 2-item, 7-point response scale with responses ranging from "Extremely dangerous" to "Completely safe". The question stem read: "How safe was it to walk around alone in the neighborhood where you

grew up…" Items read "During the daytime?" and "After dark?" CNS has parallel items framed in the present tense, with the question stem "How safe is it to walk around alone in your current neighborhood."

Indicators of Life History variation included the Arizona Life History Battery Short-Form (Mini-K; Figueredo et al., 2006), Consideration for Future Consequences (Strathman, et al., 1994), and Resource Stability (Kruger, 2018). The Mini-K is a 20-item, 7-point response scale with responses ranging from "Strongly agree" to "Strongly disagree." Items included: "While growing up, I had a close and warm relationship with my biological father."; "I have a close and warm relationship with my own children."; and "I often give emotional support and practical help to my friends." Consideration for Future Consequences is a 14-item, 7-point response scale with responses ranging from "Extremely uncharacteristic" to "Extremely characteristic." Items included: "I consider how things might be in the future and try to influence those things with my day to day behavior."; "I only act to satisfy immediate concerns; the future will take care of itself." (reverse scored); and "I think it is important to take warnings about negative outcomes seriously even if the negative outcome will not occur for many years." The Perceived Stability Scale is a 7-item, 5-point response scale from "Completely stable" to "Completely unstable." The question stem reads, "How stable (predictable, secure, reliable) are the following items in your life?" and items read "A good place to live."; "Personal safety."; and "Enough money to pay for the things you need."

Measures of health and health behaviors were adapted from the Behavioral Risk Factor Surveillance System (BRFSS; Centers for Disease Control and Prevention, 2016), the largest ongoing health survey in the world. BRFSS items included: self-reported health, "How do you rate your current health?" with a 5-point response scale from "Poor" to "Excellent"; fruit and vegetable consumption, "How many servings of fruit do you typically eat per day? (A serving of fruit is approximately 1/2 cup)" and "How many servings of vegetables do you typically eat per day? (A serving of vegetables is approximately 1 cup)"; and binge alcohol drinking, "Considering all types of alcoholic beverages, how many times during the past 30 days did you have 4 or more drinks on an occasion?" (4 for women, 5 for men). Tobacco use items included "Have you smoked at least 100 cigarettes in your entire life? 5 packs=100 cigarettes" and "Do you now smoke cigarettes every day, some days, or not at all?" with response options "Every day," "Some days," and "Not at all." The BRFSS designates those who have smoked at least 100 cigarettes and smoke "Every day" or "Some days" as current tobacco smokers. Exercise items included "During the past month, other than your regular job, did you participate in any physical activities such as running, calisthenics, golf, gardening, walking for exercise?"; "How many days per week are you physically active?"; and "On the days that you are physically active, on average how long do you exercise for? (Type the number of minutes in the box below)." Total weekly minutes of exercise were calculated as the dependent variable.

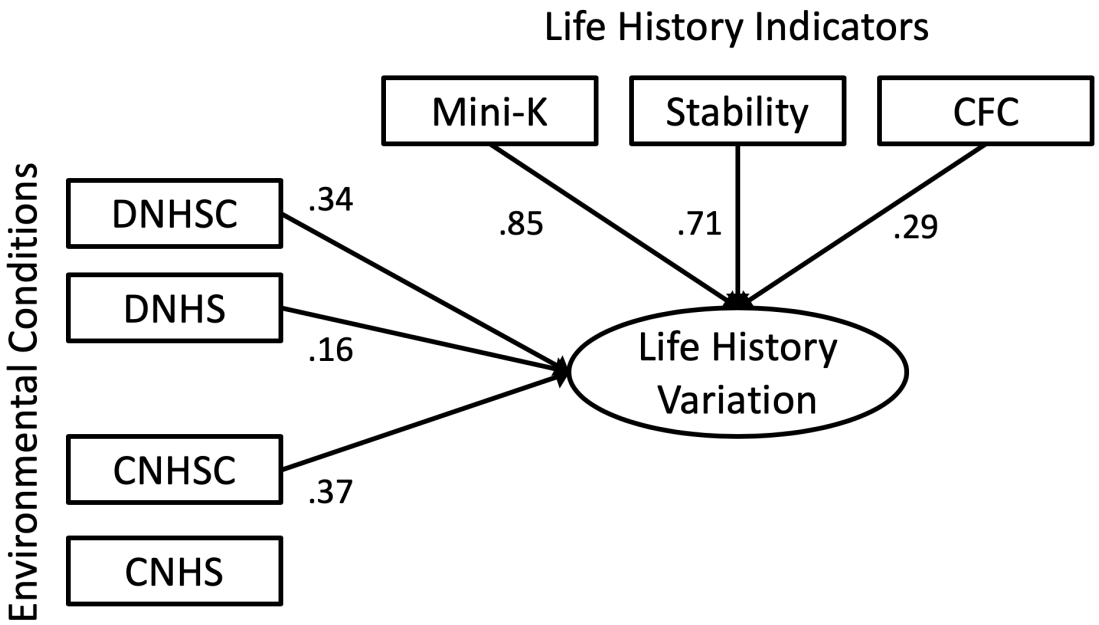
Analyses

A Structural Equation Model was developed to test the hypothetical framework of life history mediation and test research questions regarding the relative contributions of various predictors. Due to the misfit of the full Structural Equation Model, an alternative analytic process was devised to examine the hypotheses and research questions as best as possible. A Partial Structural Equation Model was developed to test research questions regarding the relationships among different measures related to life history variation and extended life history plasticity. In order to disentangle the potential indirect pathways through which neighborhood factors could pass in order to influence health behaviors, a parallel mediation analysis was estimated via Ordinary Least Squares estimation using PROCESS 3.4 (Hayes, 2017). Specifically, 5,000 percentile bootstrap resamples were drawn in order to create confidence intervals around the indirect effect terms, as well as to create confidence intervals around difference tests between the indirect effects. Individual indirect effects, total indirect effects, direct effects, and total effects are presented. While this approach cannot address temporal ordering of predictor, mediator, and outcome, it does address important shared variance considerations (Winer, Cervone, Bryant, McKinney, Liu, & Nadorff, 2016).

RESULTS

The Partial Structural Equation Model (See Figure 1) also had a poor fit to the data, though it provided insights on theoretical issues and hypotheses. The Mini-K had the highest loading on the latent factor representing indicators of life history-related variation (sharing 72% variance). This may be expected, as the Mini-K has the greatest number of items (20 vs. 14 and 7), and thus the greatest amount of variance. Resource Stability had the next highest loading on Life History Speed, sharing 50% variance. Consideration for Future Consequences significantly loaded on Life History Speed, although it only shared 8% variance. As expected, Developmental Neighborhood Social Capital and Developmental Neighborhood Safety directly predicted (slower) Life History Speed. Current Neighborhood Social Capital also predicted (slower) Life History Speed, independent of the developmental environment.

Figure 1. Partial Structural Model of Environmental Conditions and Indicators of Life History Variation

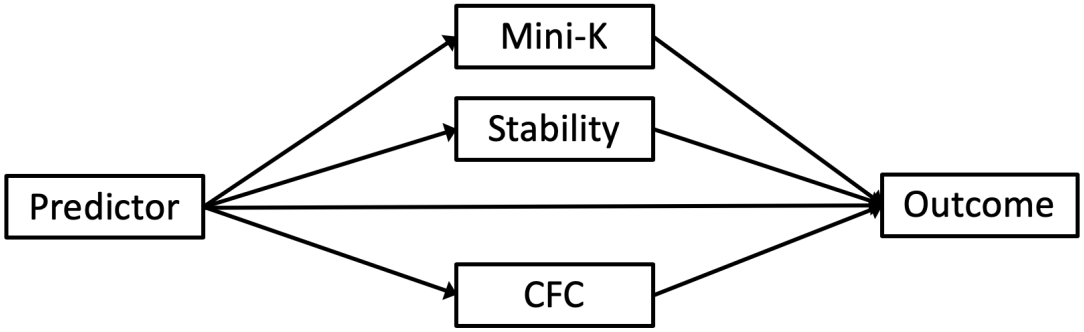


Chi-Square$_{(18)}$ = 386.67, p < .001, CFI = .655, TLI = .482, RMSEA = .198, AIC = 7228.31

Note: DNHSC = Developmental Neighborhood Social Capital, DNHS = Developmental Neighborhood Safety, CNHSC = Current Neighborhood Social Capital, CNHS = Current Neighborhood Safety, Stability = Resource Stability, CFC = Consideration for Future Consequences, CFI = Comparative Fit Index, TLI = Tucker–Lewis Index, RMSEA = Root Mean Square Error of Approximation, AIC = Akaike Information Criterion

The parallel mediation analyses (See Figure 2) identified multiple ways in which life history indicators mediated the relationships between environmental conditions and health behaviors and outcomes (See Tables 1 and 2).

Figure 2. Parallel Mediation Path Model



Note: Stability = Resource Stability, CFC = Consideration for Future Consequences

Table 1. Mediation Summary Statistics

					95% Percentile Bootstrapped CI	
Predictor	**Outcome**	**Effect**	**Estimate**	**SE**	**LL**	**UL**
Developmental	Self-Reported Health					
Neighborhood		Total	.083	.031	.023	.144
Safety		Total Indirect	.092	.015	.063	.122
		Total Direct	-.009	.030	-.068	.051
	Fruits and Vegetables					
		Total	-.080	.075	-.227	.066
		Total Indirect	.093	.032	.035	.160
		Total Direct	-.174	.078	-.327	-.020
	Exercise					
		Total	.228	.072	.087	.368
		Total Indirect	.103	.028	.051	.162
		Total Direct	.103	.028	.051	.162
	Alcohol Binge					
		Total	-.552	.126	-.799	-.306
		Total Indirect	-.164	.052	-.272	-.067
		Total Direct	-.389	.131	-.646	-.131
	Tobacco Smoker					
		Total				
		Total Indirect	-.068	.036	-.146	-.001
		Total Direct	-.185	.095	-.372	.002
Developmental	Self-Reported Health					
Neighborhood		Total	.143	.038	.069	.217
Social		Total Indirect	.126	.022	.084	.172
Capitol		Total Direct	.016	.040	-.062	.094

	Fruits and Vegetables					
		Total	-.096	.092	-.277	.084
		Total Indirect	.161	.056	.055	.272
		Total Direct	-.257	.102	-.458	-.056
	Exercise					
		Total	.196	.088	.023	.369
		Total Indirect	.147	.050	.054	.248
		Total Direct	.050	.097	-.141	.241
	Alcohol Binge					
		Total	-.686	.154	-.989	-.383
		Total Indirect	-.181	.093	-.371	-.004
		Total Direct	-.505	.172	-.842	-.168
	Tobacco Smoker					
		Total				
		Total Indirect	-.038	.034	-.109	.028
		Total Direct	-.167	.084	-.330	-.003
Current Neighborhood Safety	Self-Reported Health					
		Total	.180	.034	.113	.246
		Total Indirect	.108	.018	.077	.146
		Total Direct	.071	.034	.005	.138
	Fruits and Vegetables					
		Total	.054	.083	-.109	.217
		Total Indirect	.036	.037	-.036	.017
		Total Direct	.018	.088	-.154	.190
	Exercise					
		Total	.151	.080	-.006	.308
		Total Indirect	.054	.036	-.015	.126
		Total Direct	.097	.083	-.066	.260
	Alcohol Binge					
		Total	-.416	.141	-.692	-.140
		Total Indirect	-.109	.061	-.232	.007
		Total Direct	-.308	.147	-.597	-.019
	Tobacco Smoker					
		Total				
		Total Indirect	-.023	.052	-.122	.082
		Total Direct	.045	.111	-.172	.263
Current Neighborhood Social Capitol	Self-Reported Health					
		Total	.250	.036	.180	.320
		Total Indirect	.103	.019	.066	.142
		Total Direct	.147	.038	.073	.221
	Fruits and Vegetables					
		Total	.291	.088	.118	.464
		Total Indirect	-.010	.051	-.112	.088
		Total Direct	.301	.100	.109	.493
	Exercise					
		Total	.184	.085	.017	.352
		Total Indirect	.044	.048	-.044	.144

		Total Direct	.140	.093	-.043	.323
	Alcohol Binge					
		Total	-.172	.151	-.469	.124
		Total Indirect	-.170	.099	-.375	.011
		Total Direct	-.002	.166	-.328	.323
	Tobacco Smoker					
		Total				
		Total Indirect	-.023	.052	-.122	.082
		Total Direct	.045	.111	-.172	.263

Table 2. Estimates of Significant Indirect Effects

Predictor	Mediator	Outcome	Estimate	SE	95% Percentile Bootstrapped CI LL	95% Percentile Bootstrapped CI UL
Developmental Neighborhood Safety	Stability	Self-Reported Health	.079	.015	.052	.110
Developmental Neighborhood Safety	CFC	Self-Reported Health	.018	.007	.005	.033
Developmental Neighborhood Safety	CFC	Fruits and Vegetables	.054	.019	.021	.097
Developmental Neighborhood Safety	CFC	Exercise	.076	.021	.040	.120
Developmental Neighborhood Safety	CFC	Alcohol Binge	-.103	.030	-.167	-.051
Developmental Neighborhood Safety	Mini-K	Tobacco Smoker	-.093	.041	-.178	-.018
Developmental Neighborhood Safety	CFC	Tobacco Smoker	-.093	.041	-.178	-.018
Developmental Neighborhood Safety	Stability	Tobacco Smoker	-.022	.014	-.053	-.000
Developmental Neighborhood Social Capitol	Stability	Self-Reported Health	.120	.020	.083	.163
Developmental Neighborhood Social Capitol	CFC	Self-Reported Health	.020	.009	.005	.039
Developmental Neighborhood Social Capitol	CFC	Fruits and Vegetables	.058	.022	.021	.107
Developmental Neighborhood Social Capitol	CFC	Exercise	.088	.025	.044	.141
Developmental Neighborhood Social Capitol	CFC	Alcohol Binge	-.120	.035	-.196	-.058
Developmental Neighborhood Social Capitol	Mini-K	Tobacco Smoker	.086	.033	.026	.159
Developmental Neighborhood Social Capitol	Stability	Tobacco Smoker	-.076	.029	-.140	-.023
Developmental Neighborhood Social Capitol	CFC	Tobacco Smoker	-.048	.021	-.092	-.012
Current Neighborhood Safety	Stability	Self-Reported Health	.103	.019	.069	.144
Current Neighborhood Safety	CFC	Self-Reported Health	.007	.005	.000	.019
Current Neighborhood Safety	CFC	Fruits and Vegetables	.021	.013	.000	.051
Current Neighborhood Safety	CFC	Exercise	.034	.018	.001	.070
Current Neighborhood Safety	CFC	Alcohol Binge	-.047	.026	-.102	-.002
Current Neighborhood Safety	Mini-K	Tobacco Smoker	.132	.058	.026	.255
Current Neighborhood Safety	Stability	Tobacco Smoker	-.150	.048	-.249	-.059
Current Neighborhood Social Capitol	Stability	Self-Reported Health	.125	.020	.087	.167
Current Neighborhood Social Capitol	Mini-K	Tobacco Smoker	.132	.058	.026	.255
Current Neighborhood Social Capitol	Stability	Tobacco Smoker	-.150	.048	-.249	-.059

As a set, the models explained significant variation in all outcomes; Self-Reported Health, fruit and vegetable consumption, exercise, binge alcohol drinking, and the likelihood of being a tobacco smoker (See Table 1). Consideration for Future Consequences significantly mediated fourteen relationships, Resource Stability significantly mediated eight relationships, and scores on the Mini-K significantly mediated four relationships, all on tobacco smoking and three in the opposite direction of the prediction (See Table 2). For non-significant mediations, see Table 3.

Table 3. Estimates of Non-Significant Indirect Effects

					95% Percentile Bootstrapped CI	
Predictor	**Mediator**	**Outcome**	**Estimate**	**SE**	**LL**	**UL**
Developmental Neighborhood Safety	Mini-K	Self-Reported Health	-.005	.012	-.026	.015
Developmental Neighborhood Safety	Mini-K	Fruits and Vegetables	.031	.027	-.020	.086
Developmental Neighborhood Safety	Stability	Fruits and Vegetables	.008	.027	-.045	.061
Developmental Neighborhood Safety	Mini-K	Exercise	.020	.026	-.031	.073
Developmental Neighborhood Safety	Stability	Exercise	.007	.024	-.040	.058
Developmental Neighborhood Safety	Mini-K	Alcohol Binge	-.026	.045	-.114	.061
Developmental Neighborhood Safety	Stability	Alcohol Binge	-.035	.042	-.121	.044
Developmental Neighborhood Social Capitol	Mini-K	Self-Reported Health	-.014	.022	-.056	.029
Developmental Neighborhood Social Capitol	Mini-K	Fruits and Vegetables	.094	.059	-.016	.213
Developmental Neighborhood Social Capitol	Stability	Fruits and Vegetables	.009	.040	-.074	.084
Developmental Neighborhood Social Capitol	Mini-K	Exercise	.042	.053	-.058	.148
Developmental Neighborhood Social Capitol	Stability	Exercise	.016	.037	-.054	.092
Developmental Neighborhood Social Capitol	Mini-K	Alcohol Binge	.001	.099	-.189	.204
Developmental Neighborhood Social Capitol	Stability	Alcohol Binge	-.062	.063	-.194	.053
Current Neighborhood Safety	Mini-K	Self-Reported Health	-.002	.007	-.017	.010
Current Neighborhood Safety	Mini-K	Fruits and Vegetables	.015	.018	-.018	.053
Current Neighborhood Safety	Stability	Fruits and Vegetables	-.001	.040	-.081	.078
Current Neighborhood Safety	Mini-K	Exercise	.017	.016	-.014	.050

Current Neighborhood Safety	Stability	Exercise	.004	.037	-.066	.078
Current Neighborhood Safety	Mini-K	Alcohol Binge	-.030	.031	-.096	.026
Current Neighborhood Safety	Stability	Alcohol Binge	-.031	.060	-.155	.086
Current Neighborhood Safety	CFC	Tobacco Smoker	-.006	.012	-.035	.020
Current Neighborhood Social Capitol	Mini-K	Self-Reported Health	-.025	.018	-.060	.010
Current Neighborhood Social Capitol	CFC	Self-Reported Health	.002	.005	-.008	.013
Current Neighborhood Social Capitol	Mini-K	Fruits and Vegetables	.010	.047	-.083	.104
Current Neighborhood Social Capitol	Stability	Fruits and Vegetables	-.026	.054	-.118	.060
Current Neighborhood Social Capitol	CFC	Fruits and Vegetables	.006	.013	-.020	.034
Current Neighborhood Social Capitol	Mini-K	Exercise	.028	.045	-.058	.115
Current Neighborhood Social Capitol	Stability	Exercise	.007	.044	-.076	.095
Current Neighborhood Social Capitol	CFC	Exercise	.009	.020	-.030	.049
Current Neighborhood Social Capitol	Mini-K	Alcohol Binge	-.072	.089	-.249	.105
Current Neighborhood Social Capitol	Stability	Alcohol Binge	-.087	.073	-.233	.053
Current Neighborhood Social Capitol	CFC	Alcohol Binge	-.012	.028	-.070	.040
Current Neighborhood Social Capitol	CFC	Tobacco Smoker	-.010	.013	-.035	.020

Resource Stability was a stronger predictor than Consideration for Future Consequences (CFC) in four mediated relationships, whereas CFC was a stronger predictor than Resource Stability in three mediated relationships (See Table 4). All four environmental indicators were significant in mediated relationships, Developmental Neighborhood Safety and Developmental Neighborhood Social Capitol were significant in eight mediations, Current Neighborhood Safety was significant in seven mediations, and Current Neighborhood Social Capitol was significant in three mediations (See Table 2).

Table 4. Significant Differences between Indirect Effect Estimates

					95% Percentile Bootstrapped CI	
Predictor	**Comparison**	**Outcome**	**Estimate**	**SE**	**LL**	**UL**
Developmental Neighborhood Safety	Mini K vs Stability	Self-Reported Health	-.084	.021	-.128	-.045
Developmental Neighborhood Safety	Stability vs. CFC	Self-Reported Health	.061	.016	.031	.094
Developmental Neighborhood Safety	Stability vs CFC	Exercise	-.069	.033	-.135	-.005
Developmental Neighborhood Safety	Mini K vs Stability	Tobacco Smoker	.140	.057	.036	.262
Developmental Neighborhood Safety	Mini K vs CFC	Tobacco Smoker	.069	.029	.020	.135
Developmental Neighborhood Social Capitol	Mini K vs Stability	Self-Reported Health	-.014	.022	.084	.172
Developmental Neighborhood Social Capitol	Stability vs. CFC	Self-Reported Health	.101	.022	.060	.145
Developmental Neighborhood Social Capitol	Mini K vs Stability	Tobacco Smoker	.162	.055	.065	.282
Developmental Neighborhood Social Capitol	Mini K vs CFC	Tobacco Smoker	.134	.042	.061	.227
Current Neighborhood Safety	Mini K vs Stability	Self-Reported Health	-.106	.023	-.155	-.065
Current Neighborhood Safety	Stability vs CFC	Self-Reported Health	.096	.020	.061	.138
Tobacco Smoker	Mini K vs Stability	Tobacco Smoker	.282	.094	.108	.477
Tobacco Smoker	Mini K vs CFC	Tobacco Smoker	.138	.060	.027	.265
Tobacco Smoker	Stability vs CFC	Tobacco Smoker	-.144	.049	-.243	-.052
Current Neighborhood Social Capitol	Stability vs. CFC	Self-Reported Health	.123	.021	.084	.166

Current Neighborhood Social Capitol	Mini K vs Stability	Self-Reported Health	-.150	.033	-.216	-.088
Current Neighborhood Social Capitol	Mini K vs Stability	Exercise	.021	.077	-.131	-.166
Current Neighborhood Social Capitol	Mini K vs Stability	Tobacco Smoker	.282	.094	.108	.477
Current Neighborhood Social Capitol	Mini K vs CFC	Tobacco Smoker	.138	.060	.027	.265
Current Neighborhood Social Capitol	Stability vs CFC	Tobacco Smoker	-.144	.049	-.243	-.052

Table 5. Non-Significant Differences between Indirect Effect Estimates

					95% Percentile Bootstrapped CI	
Predictor	**Comparison**	**Outcome**	**Estimate**	**SE**	**LL**	**UL**
Developmental Neighborhood Safety	Mini K vs CFC	Self-Reported Health	-.023	.014	-.051	.003
Developmental Neighborhood Safety	Mini K vs Stability	Fruits and Vegetables	.024	.045	-.062	.112
Developmental Neighborhood Safety	Mini K vs CFC	Fruits and Vegetables	-.023	.035	-.096	.044
Developmental Neighborhood Safety	Stability vs CFC	Fruits and Vegetables	-.047	.035	-.119	.021
Developmental Neighborhood Safety	Mini K vs Stability	Exercise	.013	.044	-.075	.058
Developmental Neighborhood Safety	Mini K vs Stability	Exercise	-.056	.035	-.127	.010
Developmental Neighborhood Safety	Mini K vs Stability	Alcohol Binge	.008	.074	-.136	.159
Developmental Neighborhood Safety	Mini K vs CFC	Alcohol Binge	.077	.056	-.030	.191
Developmental Neighborhood Safety	Mini K vs CFC	Alcohol Binge	.068	.050	-.030	.167
Developmental Neighborhood Safety	Stability vs. CFC	Tobacco Smoker	-.072	.041	-.154	.006
Developmental Neighborhood Social Capitol	Mini-K vs CFC	Self-Reported Health	-.033	.025	-.081	.015
Developmental Neighborhood Social Capitol	Mini K vs Stability	Fruits and Vegetables	.085	.084	-.073	.255
Developmental Neighborhood Social Capitol	Mini K vs CFC	Fruits and Vegetables	.035	.065	-.091	.162
Developmental Neighborhood Social Capitol	Stability vs CFC	Fruits and Vegetables	-.050	.049	-.154	.040

Developmental Neighborhood Social Capitol	Mini K vs Stability	Exercise	.026	.078	-.126	.179
Developmental Neighborhood Social Capitol	Mini K vs CFC	Exercise	-.045	.060	-.163	.073
Developmental Neighborhood Social Capitol	Stability vs CFC	Exercise	-.071	.045	-.159	.018
Developmental Neighborhood Social Capitol	Mini K vs Stability	Alcohol Binge	.064	.141	-.201	.354
Developmental Neighborhood Social Capitol	Mini K vs CFC	Alcohol Binge	.121	.107	-.820	.344
Developmental Neighborhood Social Capitol	Stability vs CFC	Alcohol Binge	.057	.069	-.079	.188
Developmental Neighborhood Social Capitol	Stability vs CFC	Tobacco Smoker	-.028	.034	-.099	.037
Current Neighborhood Safety	Mini K vs CFC	Self-Reported Health	-.010	.009	-.028	.006
Current Neighborhood Safety	Mini K vs Stability	Exercise	.013	.047	-.081	.104
Current Neighborhood Safety	Mini K vs CFC	Exercise	-.017	.023	-.066	.027
Current Neighborhood Safety	Stability vs CFC	Exercise	-.029	.042	-.111	.053
Current Neighborhood Safety	Mini K vs Stability	Alcohol Binge	.002	.079	-.154	.158
Current Neighborhood Safety	Mini K vs CFC	Alcohol Binge	.018	.040	-.062	.102
Current Neighborhood Safety	Stability vs CFC	Alcohol Binge	.016	.064	-.111	.143
Current Neighborhood Social Capitol	Mini K vs CFC	Self-Reported Health	-.027	.019	-.065	.009
Current Neighborhood Social Capitol	Mini K vs Stability	Fruits and Vegetables	.036	.078	-.115	.190
Current Neighborhood Social Capitol	Mini K vs CFC	Fruits and Vegetables	.004	.050	-.094	.101
Current Neighborhood Social Capitol	Stability vs CFC	Fruits and Vegetables	-.032	.047	-.128	.058
Current Neighborhood Social Capitol	Mini K vs CFC	Exercise	.019	.050	-.081	.115
Current Neighborhood Social Capitol	Stability vs CFC	Exercise	-.001	.047	-.094	.094
Current Neighborhood Social Capitol	Mini K vs Stability	Alcohol Binge	-.015	.132	-.245	.131
Current Neighborhood Social Capitol	Mini K vs CFC	Alcohol Binge	-.060	.095	-.245	.131
Current Neighborhood Social Capitol	Stability vs CFC	Alcohol Binge	-.075	.076	-.225	.073

DISCUSSION

The central hypothesis received moderate support. Variation in self-reported health and tendencies in health-related behaviors was explained by indicators of life history variation, which in turn were explained by neighborhood environmental influences. This extends previous work demonstrating associations between one life history indicator and a range of health-related behaviors (Kruger & Kruger, 2016). However, the indicator in the previous study (the Mini-K) did not account for the expected mediated relationships in the current study. Instead, orientation towards future outcomes and the current stability of important life resources demonstrated several mediation effects. The Arizona Life History Battery Short Form, popularly known as the Mini-K, was designed to include several components thought to reflect life history speed, including developmental experiences, optimism, perseverance, risk-taking, socio-sexuality, bi-directional social support with friends and family members, and community and religious involvement.

Those who research human life history have emphasized the need to clearly determine what is being measured by life history indicators (e.g., Copping et al., 2014). The current study responds to this need by simultaneously including the Mini-K with two other indicators of life history variation, Consideration for Future Consequences and Resource Stability. These scales assess future time orientation and environmental stability, respectively. Although some of the Mini-K items overlap conceptually with those in Consideration for Future Consequences, these measures did not load highly onto the same latent factor. Resource Stability measure has some overlap with the Mini-K in items assessing social support, although it includes a broader range of life domains. Both significantly mediated the relationships between neighborhood environments and health-related behaviors.

Both developmental and current neighborhood conditions influenced tendencies to discount future health in favor of immediate rewards, exacerbating tendencies for health adverse behavior. The predictions from developmental neighborhood conditions were more comprehensive than those from current neighborhood conditions. These results provide additional support for extended life history plasticity (see also: Fraley & Heffernan, 2013; Van Gelder et al., 2013; Van Gelder et al., 2015; Kruger, 2018). Thus, one's life history may not be determined by early childhood experiences, suggesting the possibility of effective intervention during later stages of the lifespan.

Health researchers are already aware that environments shape health behaviors, though these models focus on direct environmental affordances. For example, one's diet is adversely affected by greater concentrations of fast food outlets near one's residence (Kruger et al., 2014), whereas those with household members participating in community gardens have higher consumption of fruits and vegetables (Alaimo et al., 2008). The life history framework provides a scientific basis for a broader perspective and incentives for more comprehensive structural changes. Results from the current study suggest that longer-term, risk averse strategies with health-promoting behaviors would be made more prevalent by facilitating stable access to necessary resources, safety, and community cohesion.

To fully benefit from a life history framework, Public Health as a field will need to extend its own time perspectives. It may take decades to reshape the human environment with a focus on enhancing health behaviors. The landscape of health-related influences is quite different in technologically advanced environments and those of foraging populations. People in modernized societies have far less regular exercise required in daily activities than our foraging ancestors, and the resulting imbalance between energy intake and expenditure is a major contributor to the modern obesity epidemic (Broyles et al., 2015). Industrialization and advanced technology have reduced and eliminated needs for fetching water, foraging and hunting for food, agricultural labor, and many other physical activities. Although modern physical fitness often focuses on intense strength training exercises, our modern exercise deficits are primarily in low-impact aerobic exercises such as walking (Katzmarzyk, 2014).

The implications of these evolutionary insights often converge with current recommendations for social and environmental conditions that facilitate health, though originating from a deeper understanding of the causal framework behind social and health patterns. Public areas that create safe and family friendly social space may help increase perceptions of safety and decrease levels of interpersonal crime. Areas embracing the architectural properties of defensible space may contribute to social capital and cohesion. Neighborhoods where important resources are available within walking distance and well serviced by public transportation to longer geographical ranges will encourage greater levels of exercise.

Limitations

This study has limitations. First, all data are self-reported by self-selected, paid participants. The data do not represent objective measures of health or systematic tracking of health-related behaviors. Second, the numerous parameters estimated in the present series of mediations may inflate the number of significant indirect effects, or the paths that are deemed different from one another. Thus, rather than being viewed as providing definitive insights, the present results should be viewed as warranting replication and further consideration.

Third, the life history indicators are all psychometric assessments rather than biometric measures or demographic characteristics. For other species, life history variation is indicated by biometric assessments of developmental parameters such as spacing of births, length of gestation, weight at birth, length of juvenile dependency, and age at sexual maturity. Integrating psychometric and biometric assessments may bring considerable value. Biological and demographic indicators may also be difficult to interpret in technologically advanced societies because of relatively novel factors such as caloric surplus and artificial control of fertility. Psychological measures bring value in identifying and describing the proximal mental processes guiding behavioral strategies (see Cosmides & Tooby, 1994).

Due to poorly fitting measurement models, the full structural equation model was not run. When models do not fit well, it means that there are measurement issues that will likely cause problems in evaluation of the overall model. While this is problematic for the latent variable and measurement thereof, it is possible that individual mediated relationships remain important. Therefore, our approach was to

analyze the individual relationships. Future work should address problems of measurement with the Mini-K in order to address the construct overall. Because of the large number of statistical tests, the Type I error rate is inflated. Interpretation of any individual indirect effect should be cautious, and these analyses should be replicated in future research projects.

CONCLUSION

Our technological and infrastructure advancements have improved human health through a wide variety of means, though these successes contrast with the continued challenge of promoting behavioral patterns that enhance rather than diminish health. The results of the current study suggest that progress in understanding and improving human health may be accelerated greatly by integrating insights from the most powerful explanatory system in the life sciences. Evolutionary theory, and in particular Life History Theory, provides a deep understanding of why people are not necessarily motivated to behave in ways that maximize their health and longevity. Many human health challenges are related to short time horizons and trade-offs between immediate and long-term rewards. Interventions to promote healthy behavioral patterns will benefit from efforts to improve direct environmental affordances as well as long-term environmental stability.

REFERENCES

Alaimo, K., Packnett, E., Miles, R., & Kruger, D. J. (2008). Fruit and vegetable intake among urban community gardeners. *Journal of Nutrition Education and Behavior, 40*(2), 94-101.

American Diabetes Association. (2013). Economic costs of diabetes in the US in 2012. *Diabetes Care, 36*(4), 1033-1046.

Bastien, M., Poirier, P., Lemieux, I., & Després, J.-P. (2014). Overview of epidemiology and contribution of obesity to cardiovascular disease. *Progress in Cardiovascular Diseases, 56*(4), 369-381.

Bauer, U. E., Briss, P. A., Goodman, R. A., & Bowman, B. A. (2014). Prevention of chronic disease in the 21st century: Elimination of the leading preventable causes of premature death and disability in the USA. *The Lancet, 384*(9937), 45-52.

Behrens, G., Fischer, B., Kohler, S., Park, Y., Hollenbeck, A. R., & Leitzmann, M. F. (2013). Healthy lifestyle behaviors and decreased risk of mortality in a large prospective study of US women and men. *European Journal of Epidemiology, 28*(5), 361-372.

Belsky, J., Steinberg, L., & Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: An evolutionary theory of socialization. *Child Development, 62,* 647-670.

Bentley, G. R., & Aunger, R. (2008). Practical aspects of evolutionary medicine. In S. Elton & P. O'Higgins (Eds.), *Medicine and evolution: Current applications, future prospects* (pp. 217-239). Boca Raton, FL: CRC Press.

Booth, F. W., Roberts, C. K., & Laye, M. J. (2012). Lack of exercise is a major cause of chronic diseases. *Comprehensive Physiology, 2*(2), 1143-211.

Bouchery, E. E., Harwood, H. J., Sacks, J. J., Simon, C. J., & Brewer, R. D. (2011). Economic costs of excessive alcohol consumption in the US, 2006. *American Journal of Preventive Medicine, 41*(5), 516-524.

Broyles, S. T., Denstel, K. D., Church, T. S., Chaput, J. P., Fogelholm, M., Hu, G., … & Katzmarzyk, P. T. for the ISCOLE Research Group. (2015). The epidemiological transition and the global childhood obesity epidemic. *International Journal of Obesity Supplements, 5,* S3-S8.

Centers for Disease Control and Prevention. (2016). *Behavioral Risk Factor Surveillance System 2016*. Atlanta, GA: Author. Retrieved from: http://www.cdc.gov/brfss/

Chisholm, J. S. (1999). *Death, hope and sex: Steps to an evolutionary ecology of mind and morality*. Cambridge, UK: Cambridge University Press.

Chmielewski, M., & Kucker, S. C. (2019). An MTurk crisis? Shifts in data quality and the impact on study results. *Social Psychological and Personality Science,* 1948550619875149.

Copping, L. T., & Campbell, A. (2015). The environment and life history strategies: Neighborhood and individual-level models. *Evolution and Human Behavior, 36,* 182–190.

Copping, L. T., Campbell, A., & Muncer, S. (2013). Violence, teenage pregnancy, and life history. *Human Nature, 24,* 137–157.

Copping, L. T., Campbell, A., & Muncer, S. (2014). Psychometrics and life history strategy: The structure and validity of the high K strategy scale. *Evolutionary Psychology, 12,* 200-222.

Cosmides, L., & Tooby, J. (1994). Origins of domain specificity: The evolution of functional organization. In L. A. Hirschfeld & S. A. Gelman (Eds.), *Mapping the mind: Domain specificity in cognition and culture* (pp. 85-116). Cambridge, UK: Cambridge University Press.

Figueredo, A. J., Vásquez, G., Brumbach, B. H., Schneider, S. M., Sefcek, J. A., Tal, I. R., … & Jacobs, W. J. (2006). Consilience and Life History Theory: From genes to brain to reproductive strategy. *Developmental Review, 26,* 243-275.

Finkelstein, E. A., Khavjou, O. A., Thompson, H., Trogdon, J. G., Pan, L., Sherry, B., & Dietz, W. (2012). Obesity and severe obesity forecasts through 2030. *American Journal of Preventive Medicine, 42*(6), 563-570.

Fisher, R. A. (1930). *The genetical theory of natural selection*. Oxford, UK: Oxford University Press.

Fraley, R. C., & Heffernan, M. E. (2013). Attachment and parental divorce: A test of the diffusion and sensitive period hypotheses. *Personality and Social Psychology Bulletin, 39,* 1199–1213.

Frankenhuis, W. E., & Fraley, R. C. (2017). What do evolutionary models teach us about sensitive periods in psychological development? *European Psychologist, 22,* 141–150.

Frankenhuis, W. E., Panchanathan, K., & Nettle, D. (2016). Cognition in harsh and unpredictable environments. *Current Opinion in Psychology, 7,* 76–80.

Hayes, A. F. (2017). *Introduction to Mediation, Moderation, and Conditional Process Analysis* (2nd ed.). New York, NY: The Guilford Press.

Hill, E. M., Ross, L. T., & Low, B. S. (1997). The role of future unpredictability in human risk-taking. *Human Nature, 8,* 287-325.

Jha, P., Ramasundarahettige, C., Landsman, V., Rostron, B., Thun, M., Anderson, R. N., … & Peto, R. (2013). 21st-century hazards of smoking and benefits of cessation in the United States. *New England Journal of Medicine, 368*(4), 341-350.

Johnson, N. B., Hayes, L. D., Brown, K., Hoo, E. C., Ethier, K. A., & Centers for Disease Control and Prevention (CDC). (2014). CDC National Health Report: Leading causes of morbidity and mortality and associated behavioral risk and protective factors—United States, 2005–2013. *MMWR Surveillance Summaries, 63*(Suppl 4), 3-27.

Katzmarzyk, P. T. (2014, 18 February). Personal communication.

Keough, K. A., Zimbardo, P. G., & Boyd, J. N. (1999). Who's smoking, drinking, and using drugs? Time perspective as a predictor of substance use. *Basic and Applied Social Psychology, 21,* 149-164.

Kim, K., Smith, P. K., & Palermiti, A. L. (1997). Conflict in childhood and reproductive development. *Evolution and Human Behavior, 18,* 109-142.

Kochanek, K. D., Murphy, S. L., Xu, J., & Arias, E. (2014). Mortality in the United States, 2013. *NCHS Data Brief, 178*, 1-8.

Kruger, D. J. (2011). Evolutionary theory in Public Health and the public health of evolutionary theory. *Futures, 43,* 762-770.

Kruger, D. J. (2018). Facultative adjustments in future planning tendencies: Insights on life history plasticity from the Flint Water Crisis. *Evolutionary Psychological Science, 4,* 372–383.

Kruger, D. J., Greenberg, E., Murphy, J. B, DiFazio, D. A., & Youra, K. R. (2014). Local concentration of fast food outlets is associated with poor nutrition and obesity. *American Journal of Health Promotion, 28,* 340-343.

Kruger, D. J., & Kruger, J. S. (2016). Psychometric assessment of human life history predicts health related behaviors. *Psychological Topics, 25,* 19–28.

Kruger, D. J., Reischl, T. M., & Zimmerman, M. A. (2008). Time perspective as a mechanism for functional developmental adaptation. *Journal of Social, Evolutionary, and Cultural Psychology, 2,* 1-22.

Larsen, J. K., Hermans, R. C., Sleddens, E. F., Engels, R. C., Fisher, J. O., & Kremers, S. S. (2015). How parental dietary behavior and food parenting practices affect children's dietary behavior. Interacting sources of influence? *Appetite, 89,* 246- 257.

Lewin, K. (1942). Time perspective and morale. In G. Watson (Ed.), *Civilian morale* (pp. 48-70). Oxford, UK: Houghton Mifflin.

MacArthur, R., & Wilson, E. O. (1967). *The theory of island biogeography*. Princeton, NJ: Princeton University Press.

Maciosek, M. V., Xu, X., Butani, A. L., & Pechacek, T. F. (2015). Smoking-attributable medical expenditures by age, sex, and smoking status estimated using a relative risk approach. *Preventive Medicine, 77*, 162-167.

McCullough, M. L., Patel, A. V., Kushi, L. H., Patel, R., Willett, W. C., Doyle, C., … & Gapstur, S. M. (2011). Following cancer prevention guidelines reduces risk of cancer, cardiovascular disease, and all-cause mortality. *Cancer Epidemiology Biomarkers & Prevention, 20*(6), 1089-1097.

Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science,* 244, 933-938.

Morrison, J., Fraser, I., Lurie, B., & Travis, C. (2012). *Reducing children's exposure to second-hand smoke*. Aberdeen, UK: Clinical Effectiveness Team NHS Grampian.

National Institute on Aging. (2011). *Global health and aging: NIH Publication 11-7737*. Bethesda, MD: Author.

Nettle, D. (2010). Dying young and living fast: Variation in life history across English neighbourhoods. *Behavioral Ecology, 21,* 387-95.

Nettle, D., Frankenhuis, W. E., & Rickard, I. J. (2013). The evolution of predictive adaptive responses in human life history. *Proceedings of the Royal Society B, 280,* 20131343.

Pepper, G. V., & Nettle, D. (2014). Perceived extrinsic mortality risk and reported effort in looking after health: Testing a behavioral ecological prediction. *Human Nature, 25,* 378- 392.

Pianka, E. R. (1970). On r- and K-selection. *American Naturalist, 104,* 592–596.

Richardson, G. B., & Hardesty, P. (2012). Immediate survival focus: Synthesizing life history theory and dual process models to explain substance use. *Evolutionary Psychology, 10,* 731-749.

Rowley, W. R., Bezold, C., Arikan, Y., Byrne, E., & Krohe, S. (2017). Diabetes 2030: Insights from yesterday, today, and future trends. *Population Health Management*, *20*(1), 6-12.

Sacks, J. J., Gonzales, K. R., Bouchery, E. E., Tomedi, L. E., & Brewer, R. D. (2015). 2010 national and state costs of excessive alcohol consumption. *American Journal of Preventive Medicine, 49*(5), e73-e79.

Sampson, R. J., Morenoff, J. D., & Gannon-Rowley, T. (2002). Assessing ―neighborhood effects‖: Social processes and new directions in research. *Annual Review of Sociology, 28*(1), 443-478.

Schuck, K., Otten, R., Engels, R. C., & Kleinjan, M. (2012). The role of environmental smoking in smoking-related cognitions and susceptibility to smoking in never-smoking 9–12year-old children. *Addictive Behaviors, 37*(12), 1400-1405.

Smith, S. K., Steadman, G. W., Minton, T. D., & Townsend, M. (1999). *Criminal victimization and perceptions of community safety in 12 cities, 1998*. Washington, DC: Bureau of Justice Statistics and Office of Community Oriented Policing Services, U.S. Department of Justice.

Strathman, A., Gleicher, F., Boninger, D. S., & Edwards, C. S. (1994). The consideration of future consequences: Weighing immediate and distant outcomes of behavior. *Journal of Personality and Social Psychology, 66,* 742–752.

Taylor, S. E., Repetti, R. L., & Seeman, T. (1997). Health psychology: What is an unhealthy environment and how does it get under the skin? *Annual Review of Psychology, 48*(1), 411-447.

Thorpe, K. (2009). *The future costs of obesity: National and state estimates of the impact of obesity on direct health care expenses*. United Health Foundation, The American Public Health Association and Partnership for Prevention. http://www.fightchronicdisease. com/pdfs/CostofObesityReport-FINAL.pdf.

Van Gelder, J. L., Hershfield, H. E., & Nordgren, L. (2013). Vividness of the future self reduces delinquency. *Psychological Science, 24,* 974– 980.

Van Gelder, J. L., Luciano, E. C., Weulen Kranenbarg, M., & Hershfield, H. E. (2015). Friends with my future self: Longitudinal vividness intervention reduces delinquency. *Criminology, 53,* 158–179.

Weinrich, J. D. (1977). Human sociobiology: Pair-bonding and resource predictability (effects of social class and race). *Behavioral Ecology and Sociobiology, 2,* 91–118.

Wilmot, E. G., Edwardson, C. L., Achana, F. A., Davies, M. J., Gorely, T., Gray, L. J.,… & Biddle, S. J. (2012). Sedentary time in adults and the association with diabetes, cardiovascular disease and death: Systematic review and meta-analysis. *Diabetologia, 55*, 2895-2905.

Wilson, M., & Daly, M. (1997). Life expectancy, economic inequality, homicide, and reproductive timing in Chicago neighbourhoods. *British Medical Journal, 314,* 1271-1274.

Winer, E. S., Cervone, D., Bryant, J., McKinney, C., Liu, R. T., & Nadorff, M. R. (2016). Distinguishing mediational models and anlyses in clinical psychology: Atemporal associations do not imply causation. *Journal of Clinical Psychology, 72*(9), 947-955. doi: 10.1002/jclp.22298.

Woolf, S. H., & Schoomaker, H. (2019). Life expectancy and mortality rates in the United States, 1959-2017. *Journal of the American Medical Association, 322,* 1996–2016.

Zhang, W., Bansback, N., & Anis, A. (2011). Measuring and valuing productivity loss due to poor health: A critical review. *Social Science & Medicine, 72*(2), 185-92.

Zimbardo, P., & Boyd, J. (1999). Putting time in perspective: A valid, reliable individual differences metric. *Journal of Personality and Social Psychology, 77,* 1271–1288.