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A State-Level Analysis of Mortality and Google Searches for Pornography: Insight from Life History Theory

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Abstract

Due to the widespread popularity of pornography, some studies explored which individual factors are associated with the frequency of pornography use. However, knowledge about the relationship between socioecological environment and pornography consumption remains scant. Based on life history theory, the current research investigated the association between state-level mortality and search interest for pornography using Google trends. We observed that, in the U.S., the higher mortality or violent crime rate in a state, the stronger search interest for pornography on Google. The results expand the literature regarding the relationship between socioecological environment and individuals' online sexual behavior at the state level.

Keywords Pornography · Mortality · Violent crime rate · Life history theory · Google trends

Introduction

With the development of information technology, the internet has been one of the most indispensable tools in our daily life all around the world. From 1997 to 2016, the number of households with internet access in the U.S. rose from 17 to 82% (U.S. Census Bureau, 2016). Meanwhile, online sexual activities are becoming more frequent (Cooper, Galbreath, & Becker, 2004; Fisher & Barak, 2001; Goodson, McCormick, & Evans, 2000; Peter & Valkenburg, 2006). Sex has become the second frequent theme of web searches (Hochstotter & Koch, 2008; Spink, Ozmutlu, & Lorence, 2004). Due to the prevalence of pornography (porn), researchers have been interested in which factors are involved. For example, compared to women, men are the main consumers of porn (e.g., Albright, 2008; Buzzell, 2005). Some studies also explored the association between relationship status and porn consumption and found that divorced individuals were more likely to consume sexually explicit material on the internet than singles (Albright, 2008). These studies generally investigated which factors are related to the frequency of using porn from the perspective of individual differences. However, expect for these individual factors, we believe that external environmental factors could also play an important role in porn use. For instance, a study found that the popularity of Google searches regarding sex changes with the seasons (Markey & Markey, 2013). Therefore, the present study, based on life history theory, focused on the relationship between socioecological environment and porn use at the group level.

Life History Theory

Life history theory is a mid-level evolutionary theory, providing a framework to understand how organisms allocate energy and time across their lifetime (Stearns, 1992). This theory proposes that organisms cannot make maximization investment in all life aspects since the resources available to organisms are limited. In other words, organisms cannot simultaneously allocate energy to different life tasks, such as physical growth and reproduction. They need to face how to optimally allocate and use resources to survive and reproduce better. Thus, the notion of the trade-off is central to life history theory. When more energy is devoted to one's own growth or embodied capital, less energy is available to be spent on finding mates (Kaplan, Hill, Lancaster, & Hurtado, 2000). This resource-allocation dilemma leads to a basic trade-off—whether and

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when to invest in somatic effort (the development and growth of one's mind and capacity) versus reproductive effort (courtship, reproduction, and childcare) (Hill, 1993). Organisms vary in how they navigate these trade-offs—regarded as variability in their life history strategy.

Life history strategy is a set of particular behavior patterns. Organisms adopting slow or fast life history strategies show systematic differences in several aspects. Specifically, organisms that adopt fast strategies usually reach sexual maturity earlier, reproduce earlier and attach importance to the number of offspring. Organisms adopting slow life history strategies usually reproduce later and show more concern about their own growth and the quality of their offspring (Ellis, Figueredo, Brumbach, & Schlomer, 2009).

Environmental Contingency in Life History Strategies

Although life history strategy was originally applied to explain behavioral differences between species, researchers have documented that organisms within species also adopt various life history strategies (e.g., Ellis et al., 2009). If organisms face varying environmental conditions, they would navigate different energy allocation strategies. In rats, for example, variation in maternal behavior affects offspring's timing of puberty, defensive responses, and reproductive behavior (Cameron et al., 2005).

Compared to other primates, humans reach sexual maturity later, reproduce later and have relatively fewer offspring, but invest more in each offspring (Kaplan et al., 2000). Such an investment pattern is often referred to as a slow life history strategy. Accruing evidence, however, indicates that there are tremendous differences among individuals in life history strategies (Chisholm, 1993; Ellis, 2004). Human life history strategy is sensitive to particular environmental cues (Sear, 2015). People face different adaptive problems due to living in different socioecological environments. Therefore, individuals need to constantly adjust their life history strategy according to the current socioecological environment to maximize their benefit of survival and reproduction. According to life history theory, external mortality is an extremely important factor influencing people's life history strategy (e.g., Ellis et al., 2009). Individuals living in a harsh and unpredictable environment are more likely to adopt a fast history strategy and devote more energies to mating and reproductive effort in the face of dying from disease or violence without any offspring. For example, existing works have found that people who live in a higher violent crime rate area tend to invest more energy to reproductive effort (e.g., Griskevicius, Delton, Robertson, & Tybur, 2011, Study 1).

Life History Strategy, Sexual Strategy, and Porn Use

Fast versus slow life history strategies are characterized by not only reproductive effort, but also a wide variety of other traits and behaviors, such as sexual strategies (e.g., Fernandes, Menie, Hutz, Kruger, & Figueredo, 2016; Patch & Figueredo, 2016). Since people with fast life history strategy usually invest more energy in mating effort, they prefer short-term mating, seeking more sex partners, and higher frequency of intercourse (Dunkel, Mathes, & Decker, 2010). In contrast, individuals with slower life history strategy have more positive attitudes toward long-term mating and monogamy (Olderbak & Figueredo, 2009). One study found that women growing up in high adversity childhood environments had higher sexual motivation, participated in more sexual activities, and initiated sex more frequently with partners on cycle day, whereas women from less adverse environments reported less sexual motivation and sexual activities (Dinh, Pinsof, Gangestad, & Haselton, 2017). These findings indicate that fast life history strategy is strongly associated with unrestricted sociosexuality.

With the popularity of the internet, individual sexual attitudes and strategies can be expressed not only through actual sexual behavior, but also through more private online activities. In the perspective of evolutionary psychology, porn use, to some extent, reflects individuals' sexual strategies and sexual fantasy (Ellis & Symons, 1990). Malamuth (1996) argued that the consumption of sexually explicit material is, at least in part, "the result of inherent differences in evolved sexuality mechanisms interacting with environmental forces, and not the exclusive byproduct of differences in other evolved mechanisms or differences in environmental input, or both" (p. 15). For example, men reported higher frequent use of pornography than women and often utilized porn as a means of providing physical gratification without commitment (e.g., Albright, 2008; Buzzell, 2005; Cooper et al., 2004; Malamuth, 1996). This phenomenon is in accordance with male sexual strategies and sexual fantasy that men prefer short-term relationships and have more frequency of sexual fantasy than women (e.g., Ellis & Symons, 1990; Gangestad & Simpson, 2000). Sex differences in porn use, unsurprisingly, mirror the sex differences in personal sexual fantasies and strategies (Salmon, 2012). Some empirical research also found that porn consumption was associated with having more sexual partners and more positive attitudes toward teenage sex, adult premarital sex, and extramarital sex (e.g., Peter & Valkenburg, 2011; Willoughby, Carroll, Nelson, & Padillawalker, 2014). Therefore, we considered that individuals who devote more effort to short-term mating also tend to have more consumption of sexually explicit material. In addition, compared with actual sexual behavior, internet porn use is generally a more accurate reflection of individual sexual desire. In real life, even if expecting more short-term

relationships, many people have trouble putting it into practice owing to considerations about social norms, venereal diseases or rejection by a partner. Nevertheless, using sexually explicit materials provides a safe and convenient way to express one's own sexual desire.

The Present Study

According to life history theory, individuals' life history strategy is shaped by the current or expected socioecological environment. When living in a society with high risk of death, people are more likely to adopt fast life history strategy, thereby more frequently using porn on the internet. The present study examined this idea using Google trends. Google trends could collect the popularity of searching for porn-related terms of different regions in a certain period of time. It can help us to obtain the data of search interest for porn objectively and ecologically and reduce the error of subjective report caused by social desirability.

The present study chose the U.S. as the target society, not only because there are thorough public data available and sufficient units of analysis at the state level but also because the potential differences in culture, political systems, language, and internet use policies could be controlled to some extent with data collected from different areas within one society. We hypothesized that the higher mortality the state has, the more search interest for sexual content on Google. In addition, except for mortality, we believed that as a mortality cue, violent crime rate (e.g., murder, robbery) which has a direct threat to physical health could also affect porn use. For this, we put forward the hypothesis that the higher violent crime rate of a state is, the more search interest for porn on Google are.

Method

We obtained data on mortality, violent crime rate, and the popularity of Google searches for porn, as well as control variables like GDP per capita and sex ratio for each state. We examined zero-order correlations between mortality/violent crime rate and Google searches for porn. Then, we conducted multivariate regression analyses to examine the relationship between mortality/violent crime rate and search interest for porn controlling for GDP per capita and sex ratio.

Measures

Porn Use The present study employed Google trends to measure public search interest for porn-related terms in 50 states for each year from 2013 to 2017 (from 1 January 2013 to 31 December 2013; from 1 January 2014 to 31 December 2014; from 1 January 2015 to 31 December 2015; from 1 January 2016 to 31 December 2016; from 1 January 2017 to 31 December 2017). Google trends data are adjusted in two steps (see http://support.google.com/trends/). Firstly, within a given time period, relative search interest of different regions for a term are calculated by dividing search volumes for that term by total search volumes, which means that it eliminates the influence of population variation of different regions and search interest of each state is comparable. Secondly, the score of search interest is scaled on a range of 0–100. Specifically, the highest one was viewed as 100 fixedly; the other scores are proportioned to it. Therefore, a state with a score of 100 has the highest search interest for a term during that time. Other states' scores on search interest for that term would be calculated based on the state with the highest score. For example, a state with a score of 50 has only a half of search popularity for a term of a state with a score of 100. As prior research demonstrates, Google Trends is an effective means through which public interest can be examined (e.g., MacInnis & Hodson, 2015; Scheitle, 2011).

We adopted the search data of the 10 keywords ("boobs," "hentai," "milf," "nude," "porn," "pussy," "sex," "tits," "xvideos," "xxx") used in previous researches (Markey & Markey, 2010, 2013) as a composite indicator of porn use. Search terms show matches for all terms in the query, in the language given (see https://support.google.com/trends/answer/4359550?hl=en&ref_topic=4365530).

Mortality We obtained age-adjusted death rate per 100,000 standard population for each state for each year from 2013 to 2017 from the U.S. Centers for Disease Control and Prevention (Kochanek, Murphy, Xu, & Arias, 2019; Kochanek, Murphy, Xu, & Tejada-Vera, 2016; Murphy, Xu, Kochanek, Curtin, & Arias, 2017; Xu, Murphy, Kochanek, Bastian, & Arias, 2018; Xu, Murphy, Kochanek, & Bastian, 2016). Age-adjusted death rate controls for the effects of differences in population age distributions and make the different geographic areas more comparable. Statistically, it is a weighted average of age-specific death rates, where the weights represent the fixed population proportions by age. The U.S. 2000 standard population can be used when calculating age-adjusted rates.

Violent Crime Rate Violent crime rate per 100,000 inhabitants for each state for each year from 2013 to 2017 was obtained from the U.S. Federal Bureau of Investigation (2013–2017). Violent crime includes the offenses of murder and non-negligent manslaughter, rape, robbery, and aggravated assault.

GDP Per Capita GDP per capita as an indicator of resource scarcity affects life history strategies (Ellis et al., 2009). However, since the current research wanted to focus on the unique relationship between mortality cues and porn use, GDP per capita would be controlled for in multivariate

regression analyses. GDP per capita within each state for each year from 2013 to 2017 was obtained from U.S. Bureau of Economic Analysis (2013–2017).

Sex Ratio We controlled sex ratio because porn consumption was predominantly a male activity (Albright, 2008). Sex ratio within each state for each year from 2013 to 2017 was obtained from American Community Survey (2013–2017).

Results

Table 1 shows all descriptive statistics, and we examined zero-order correlations between these variables for each year from 2013 to 2017 in the 50 states (Table 2). As expected, mortality positively correlated with search interest for porn-related terms ($r_{2017} = .67, p < .001; r_{2016} = .70, p < .001; r_{2015} = .32, p = .022; r_{2014} = .43, p = .002; r_{2013} = .60, p < .001$), as did violent crime rate ($r_{2017} = .39, p = .005; r_{2016} = .41, p = .003$). These correlational coefficients reach medium to large effect size (Cohen, 1988).

Next, we conducted multivariate regression analyses to explore whether the relationship between mortality/violent crime rate and search interest for porn-related terms was robust. After controlling for GDP per capita and sex ratio, mortality was positively associated with the popularity of porn-related terms ($\beta_{2017} = .76, p < .001; \beta_{2016} = .77, p < .001; \beta_{2014} = .43, p = .008; \beta_{2013} = .61, p < .001$) (see Table 3). In other words, for each one SD increase in mortality, search interest for porn increased by .43 to .76 SDs while holding GDP per capita and sex ratio constant in the models. The results supported the hypothesis on the state level that the higher mortality the state has, the more frequently the people use porn. In addition, we found that violent crime rate was also positively related to search interest for porn-related terms on Google ($\beta_{2017} = .35, p = .006; \beta_{2016} = .37, p = .003; \beta_{2013} = .28, p = .029$) (see Table 4). That is, if violent crime rate increases by one SD, the mean of search interest increases by .28 to .35 SDs while holding GDP per capita and sex ratio constant in the models. The results indicated that the higher violent crime rate in a state, which can directly threaten one's life security, the stronger the interest of searching for porn on Google.

Table 1 Descriptive statistics

	2017				2016				2015			
	M	SD	Min	Max	*M*	SD	Min	Max	*M*	SD	Min	Max
GDP per capita	52,066.48	9781.16	33,646	71,831	51,625.48	9722.55	33,504	70,947	51,535.26	10,075.89	33,386	72,652
Sex ratio	49.43	.80	48.4	52.3	49.41	.79	48.4	52.3	49.40	.80	48.4	52.4
Mortality	756.29	89.79	584.9	957.1	751.71	88.62	572.0	948.9	757.25	88.01	588.2	963.7
Violent crime rate	377.12	148.86	121.0	829.0	378.16	147.30	124.0	804.6	364.14	138.47	119.3	730.8
Google searches	71.18	10.22	55	100	73.38	10.42	56	100	52.18	9.24	39	100

	2014				2013			
	M	SD	Min	Max	*M*	SD	Min	Max
GDP per capita	50,779.76	10,023.22	33,247	76,357	50,121.14	9785.50	33,332	74,283
Sex ratio	49.38	.78	48.4	52.2	49.37	.77	48.3	52.2
Mortality	748.96	88.60	588.7	937.6	748.06	87.25	590.0	959.6
Violent crime rate	346.57	126.55	102.6	635.7	351.83	124.53	123.6	638.7
Google searches	64.74	9.46	50	100	70.72	7.77	57	100

$N = 50$. Google search variables range from 0 (lowest search volume) to 100 (highest search volume)

Table 2 State-level correlations between variables

	Zero-order (2017)	Zero-order (2016)	Zero-order (2015)	Zero-order (2014)	Zero-order (2013)
	Pornography use				
GDP per capita	− .43**	− .44**	− .23	− .29*	− .35*
Sex ratio	.09	.09	.15	.12	.16
Violent crime rate	.39**	.41**	.07	.07	.27[†]
Mortality	.67***	.70***	.32*	.43**	.60***

$N = 50$. ***$p < .001$; **$p < .01$; *$p < .05$; [†]$p < .10$

However, when putting mortality and violent crime rate in the same models simultaneously, violent crime rate was not significantly related to searching for porn-related terms ($ps > .07$), but mortality was still positively associated with porn-related Google searches ($\beta_{2017} = .68$, $p < .001$; $\beta_{2016} = .68$, $p < .001$; $\beta_{2014} = .44$, $p = .009$; $\beta_{2013} = .57$, $p < .001$) (see Table 5). That is, when holding GDP per capita, sex ratio, and violent crime rate constant in the models, mortality increases by one SD, the average search popularity for porn-related content increases by .44 to .68 SDs.

Discussion

The current study examined the positive associations between socioecological environmental factors and search interest for porn. Specifically, a state with higher mortality or violent crime rate demonstrated more active searches for porn on Google, even after controlling for GDP per capita and sex ratio of each state. The findings suggest that internet porn use is not only related to individual characteristics, but also to some socioecological factors, thus showing differences at the regional level.

The current research provided new insights into the speculation on one possible reason for the difference of the frequency of using porn: mortality. Although there have been many studies to explore the individual factors related to the porn consumption, our knowledge about the association between online sexual activities and specific socioecological factors remains relatively poor. Based on life history theory, we found that there was a positive correlation between the macro-socioecological environment and online porn use. Specifically, the higher the mortality of the state, the higher the popularity of Google searches for porn, which might be a representation of a fast life strategy. Moreover, violent crime rate as a cue of mortality, which has a direct threat to physical health, was also found to be positively correlated with searches interest for porn on Google. But after controlling for mortality, violent crime rate was no longer related with search interest for porn-related terms, which means that their relationship can be explained by mortality. Similarly, we also found that the association between porn use with mortality than with GDP per capita.

Table 3 Multivariate regression models

Predictor	Model 1 (2017)			Model 2 (2016)			Model 3 (2015)			Model 4 (2014)			Model 5 (2013)		
	β	t	p	β	t	p	β	t	p	β	t	p	β	t	p
GDP per capita	−.001	−.01	.994	−.04	−.30	.767	−.12	−.70	.489	−.14	−.92	.362	−.12	−.94	.349
Sex ratio	.31**	2.93	.005	.32**	3.18	.003	.27†	1.91	.063	.28*	2.07	.044	.34**	2.96	.005
Mortality	.76***	5.51	<.001	.77***	6.16	<.001	.33†	1.97	.055	.43**	2.79	.008	.61***	4.82	<.001

$N = 50$. ***$p < .001$; **$p < .01$; *$p < .05$; †$p < .10$

Table 4 Multivariate regression models

Predictor	Model 1 (2017)			Model 2 (2016)			Model 3 (2015)			Model 4 (2014)			Model 5 (2013)		
	β	t	p	β	t	p	β	t	p	β	t	p	β	t	p
GDP per capita	−.44***	−3.58	.001	−.47***	−3.87	<.001	−.30*	−2.04	.047	−.35*	−2.47	.017	−.44**	−3.35	.002
Sex ratio	.16	1.31	.197	.20	1.61	.114	.23	1.56	.125	.23	1.58	.122	.30*	2.27	.028
Violent crime rate	.35**	2.88	.006	.37**	3.19	.003	.04	.31	.757	.06	.47	.642	.28*	2.26	.029

$N = 50$. ***$p < .001$; **$p < .01$; *$p < .05$; †$p < .10$

Table 5 Multivariate regression models

Predictor	Model 1 (2017)			Model 2 (2016)			Model 3 (2015)			Model 4 (2014)			Model 5 (2013)		
	β	t	p	β	t	p	β	t	p	β	t	p	β	t	p
GDP per capita	−.03	−.25	.804	−.08	−.62	.540	−.11	−.66	.516	−.13	−.84	.405	−.15	−1.17	.247
Sex ratio	.28*	2.62	.012	.29**	2.98	.005	.27†	1.91	.063	.28*	2.07	.045	.34**	3.04	.004
Violent crime rate	.19†	1.86	.070	.18†	1.79	.079	−.04	−.25	.805	−.05	−.38	.708	.17	1.56	.127
Mortality	.68***	4.81	<.001	.68***	5.20	<.001	.34†	1.94	.059	.44**	2.74	.009	.57***	4.39	<.001

$N = 50$. ***$p < .001$; **$p < .01$; *$p < .05$; †$p < .10$

The present research supported the link between mortality and online sexual activities at the group level. Although previous studies have explored the relationship between life history strategies and sexual attitudes or behaviors (e.g., Dunkel, Summerville, Mathes, & Kesserling, 2015; Simpson, Griskevicius, Kuo, Sung, & Collins, 2012), most of the data came from subjective reports at the individual level. However, individuals' subjective reports might be biased. For example, they might hide the facts for political or religious reasons (MacInnis & Hodson, 2015), or be unwilling to disclose since sex is still a subject that is difficult to talk about. Obviously, compared to other approach, the data from Google trends not only could provide large-scale samples, but has relative higher objectivity and ecological validity.

Several limitations of this research should be considered. First, because of conducting state-level correlation analyses of mortality and Google searches for porn-related terms, the result cannot indicate that individuals who perceive higher mortality have more interest in porn. And the correlation can be interpreted as reflecting the reverse. In other words, it is possible that more frequent porn use would give rise to higher mortality or violent crime rate. Therefore, future research should examine further the causal relationship between mortality and porn use on individual level. Second, although we believe that adopting a fast life history strategy is a crucial reason for searching porn more frequently, the current study still cannot exclude other possible explanations. For instance, previous studies found that some consumers view porn as a way of coping with anxiety and stress (Cooper, Morahan-Martin, Mathy, & Maheu, 2002; Paul & Shim, 2008). In other words, it is possible that high stress triggered by high violent crime or mortality could also lead to more porn use. Third, Google trends do not provide specific information about users. Therefore, we are unable to conduct more detailed research to explore the interaction between individual characteristics and local mortality for porn use. For example, a study found that when facing mortality cues, individuals who grew up in wealthier households adopted a slower life history strategy than those who grew up in poorer households (Griskevicius et al., 2011). Thus, mortality cues may stimulate people feeling poor as children to consume porn more frequently, while those feeling rich to use it less often. Finally, using search interest for porn-related terms on Google as indicators of porn use have some defects. People who consume porn regularly may go straight to the site that offers porn like Pornhub, or search for porn using special terms and search engines like Bing or DuckDuckGo. Future research can combine multiple ways to measure porn consumption to obtain more comprehensive and accurate results.

Compliance with Ethical Standard

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