An Evolutionary Approach to Binge Drinking Impression Formation: A Cross-Cultural Comparison Between France and Peru

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Abstract
Evolutionary medicine proposes studying alcohol use and abuse through the lens of modern evolutionary theory. This study follows this approach and uses an evolutionary framework to predict how young adults (18–35 years old) form impression of a binge drinker. We predicted that displaying sexual dysfunctions (short-term risk) in a binge drinking video would negatively influence attitudes and expectations of a target when compared to cognitive (short-term risk) or long-term deficits. In the following studies, we use a Zahavian framework to understand and influence impression formation of a male binge drinker among women (intersexual selection) and men (intrasexual competition) participants in a subsequent task. Via a randomized experimental online study in France (N = 177, M = 23.39 [4.91], 43.50% men) and a preregistered conceptual replication study in Peru (N = 176, M = 25.61 [4.76], 53.41% men), women exposed to a binge drinking video—describing sexual impotence after a binge drinking episode—tended to downgrade attractiveness evaluation of the binge drinker. However, male participants were not impacted by the different types of signals displayed in the videos. These results show that evolutionary theory could help us understand impression formation in binge drinking context and call for gender-specific health messages.

Keywords
evolution, health, alcohol, prevention, mating

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Alcohol consumption is the second largest cause of death in France with more than 40,000 victims a year (Guérin et al., 2013; Nguyen-Thanh & Guignard, 2019), €120 billion of health cost a year, and numerous cancers and cardiovascular, digestive, and mental diseases directly imputable to alcohol (Corrao et al., 2004; Kopp, 2015; Spach, 2016). On the other hand, it was reported that in 2013, the prevalence of alcohol consumption per month in Peru was 34.5% while the annual prevalence rose to 59.4% (Peñaranda et al., 2014). Binge drinking consists of five or more drinks for men or four or more drinks for women in about 2 hr (National Institutes on Alcohol Abuse and Alcoholism, 2004), equivalent to a BAC of 0.08 gram percent or above (Courtney & Polich, 2009). Binge drinking research generally lacks theory-driven hypotheses (Durkin et al., 1999) or focuses on proximate explanations such as planned behavior (Johnston & White, 2003), self-control (Gibson et al., 2004), or alcohol expectancies and self-efficacy theories (Oei & Morawska, 2004).

Understanding risky drinking through the lens of an evolutionary framework can help analyze distal causation of the phenomenon and draw precise experimental hypotheses. In particular, male’s ability to drink large quantities of alcohol in a short period can be analyzed as multiple signals toward potential female mates and male competitors. Vincke (2016) found that Flemish women exposed to vignettes describing a man drinking occasionally was rated as more attractive than a...
man never drinking or drinking frequently. For short-term mating, both occasional and frequent drinking were evaluated as more attractive than nondrinking. In another study, Vincke (2017) revealed the existence of a moderate correlation between binge drinking and the level of sexual unrestrictedness (i.e., higher sociosexual orientation score and short-term mating orientation) confirming that the signaler is sexually short-term oriented. These studies confirm the general differences in risk-taking perception between risk avoiders (attractive for long-term mating) and risk takers (attractive only for short-term mating, see Sylwester & Pawłowski, 2011).

One way to act against those “positive” signals would be to update people’s explicit beliefs about both sexual and cognitive impairments caused by binge drinking and thus negatively affect participants’ beliefs/impressions of binge drinking practices. One way to do that is by appealing fear in messages which is common practice in public health (see, for instance, prevention campaign videos by the Institut national de prévention et d’éducation pour la santé in France). Tannenbaum and colleagues (2015) analyzed data from 248 studies involving manipulation of depicted fear versus comparison group and found a small positive effect of fear on attitude/intentional/behavioral changes (\( d = .29; \) though stronger for drinking/drugs use, \( d = .49 \)). Meta-regressions indicated that efficacy statements, high susceptibility and severity, one-time exposition, and large percentage of women in the sample might increase the effect of fear appeal on attitudinal/behavioral changes. More specifically, associating binge drinking with sexual dysfunctions may be particularly effective in changing attitude toward the target (and eventually toward binge drinking) among adolescents and young adults’ participants entering sexual competition (White & Albarracin, 2018).

Various attempts to reduce binge drinking have been implemented in Western Europe, trying to prevent such risky conducts from emerging in teenagers and young adults (Gallopel-Morvan et al., 2016; Jessor et al., 1991). For instance, Freimuth and colleagues (1997) used a video-based program for seventh grade in the United States including different types of drugs (e.g., for alcohol, the video mentioned risks linked to substance-abusing families). The video-based program significantly increased health knowledge and ability to criticize advertisements when compared to a classical program (i.e., role-playing, work booklets, and discussion). However, the different types of risks associated with binge drinking are usually mixed up together (peer pressure, violence, sexual abuse, ethylic coma and accidents, etc.). We are aware that this “one bullet, multiple targets” strategy is usually in place in health policy (see D’Amico & Fromme, 2002, for binge drinking or Yom-Tov et al., 2018, for eating behaviors; also see projects such as Housing First to treat people for addiction, psychiatric disorders, and so on). However, we think a “one bullet, one target” strategy may be more adapted for binge drinking messages because of the gender differences present in risky drinking (i.e., young drinkers and sex-oriented messages, see Babor et al., 2010) but also because of the deep evolutionary roots that may constitute the practice and its costly signal components.

In this perspective, we used a professional video-making company (B Production, France), but instead of mixing the different risks at play, we made several videos in the exact same conditions but with different outcomes: sexual impotence OR cognitive impairing OR long-term effects (cancers, cardiovascular diseases). We proposed that the sexual dysfunction clip will be the most impactful on alcohol attitude and expectancies, followed by the cognitive one and the long-term video. Moreover, we also think that the two short-term risks videos (sexual and cognitive) will be more impactful than the long-term clip, given that our sample is relatively young (24–25 years old) and that previous work showed adolescents to be more sensitive to unambiguousness even when using age as a continuous predictor (see Tymula et al., 2012). It is thus possible that our participants will be more sensitive to short-term risks signaling (sexual impotence, attention/memory difficulties) when compared to long-term risks messages. Distinguishing risks at play in binge drinking while targeting specific populations might be the key aspect to affect such conducts or at least to send relevant signals aiming at reducing positive attitudes and expectancies toward binge drinking.

**Social Theories of Binge Drinking**

Over the past two decades, various sociopsychological theories have intended to propose a framework for generating testable and predictable hypotheses. Cognitive theories, for instance, have proposed to analyze alcohol expectancies and drinking refusal self-efficacy in order to explain four distinct types of drinking styles (normal/social drinkers, binge drinkers, regular heavy drinkers, and problem drinkers or alcoholics; see Oei & Morawska, 2004). Attitudinal theories usually refer to Ajzen’s model (attitudes, social normal, and perception of control of binge drinking, see Ajzen, 1985) of planned behavior (explaining up to 58–69% in binge drinking intentions; see Norman et al. 2007; Johnston & White, 2003). Social bond theory (Durkin et al., 1999) and self-control theory (Gibson et al., 2004) proposed to integrate beliefs, peer behavior, and environmental factors to explain and predict binge drinking frequency.

These theories present clear interests as they try to conceptualize binge drinking through attitudinal, motivational, and situational characteristics. However, they somehow failed to clearly distinguish between solitary and collegial binge drinking. While the former is more relevant through the lens of alcoholism, the latter appears to have an important social component, which may be to express competition, masculinity, or entertainment. To tackle the deep-rooted behaviors that constitute binge drinking, a possible strategy is to go beyond proximal explications and propose an existing evolutionary framework that spans the different physical and ecological factors involved in that particular type of risk (Hill & Chow, 2002).
Costly Signal Theory

According to costly signal theory (Zahavi, 1975; Zahavi & Zahavi, 1999), only men who could afford those type of signals would engage in such behaviors. Originally rarely used in evolutionary biology, this theory gained popularity after Grafen (1990) found a pair of evolutionary stable strategies that are a function of a male’s true genetic quality, his level of advertising, and the observed value of the male by the female (which depends largely on the perceived value of the male). Any male peacock (Loyau et al., 2005) capable of maintaining and displaying such characters indicate a high genetic quality, yet they also expose the owner to increased possible aggressions (i.e., it may be more difficult to fight or to escape because of the physiological cost of the feature, see Mateos & Carranza, 1997).

Among the myriad of risks at play in human interactions, binge drinking is a feature that fits very well with Grafen’s criteria in the Zahavian framework. Indeed, social event generally allows for a public test of an individual’s tolerance, which may be explicitly written in some drinking games’ rules (level of advertising). On the other hand, the binge drinker can hardly lie about his or her digestive capacities and would generally give up once his or her limits are reached (observed value). Finally, how the individual tolerates the alcohol is a direct signal of true genetic quality and his or her capacity to tolerate the toxic effects of alcohol abuse on the body (true genetic quality). Indeed, tolerance to alcohol is understood from an evolutionary point of view as a context-dependent trait that may have evolved through intrasexual competition, is often exaggerated, and explains human cognitive sex differences notably in gastric alcohol dehydrogenase (Geary, 2017). Thus, tolerating the toxic effects of alcohol could be understood through the lens of costly signal theory as it informs about the ancestral true genetic quality of the individual.

To tackle the binge drinking phenomenon, we attempt to evaluate how the different risks displayed in equivalent binge drinking videos would impact the impression formations of the binge drinker. We predict that the video describing sexual impotence should be the most detrimental in the evaluation of the binge drinker in young adults in the middle of the sexual competition (18–35 years old; see Kanny et al., 2018). Despite Zahavian hypothesis being primarily applied to intersexual selection (and so should work better with a female sample), we induce that male participants would also be affected when evaluating the competitiveness of the masculine target.

Short- Versus Long-Term Risks

The time line of the risks displayed in our videos made our theory compete with a more proximal behavioral economical one. Adolescents have been shown to be more willing to gamble and take risks when exposed to ambiguous economic risks, while actually taking fewer risks than adults when the odds at play were clearly exposed (Tymula et al., 2012). Since Tymula and colleagues (2012) also found a positive correlation with age (as a continuous predictor), we think that our relatively young sample (24–25 years old) could still be impacted by short-term messages when compared to long-term ones. As a consequence, a parallel hypothesis may postulate that the sexual and cognitive deficits spots will be more impactful globally than the long-term video.

We ran two studies to test our predictions in a between-subject design. First, we ran the study with French participants between 18 and 35 years old through social networking sites (i.e., mainly Facebook) in a mostly occidental individualist society. Then, we tried to replicate those findings in an online sample of Peruvians to test whether those results hold in a very different context (nonoccidental collectivist). Taken together, those findings should be used as a first step toward understanding formation impression during binge drinking episodes.

General Methods

In both studies, participants were exposed in a between-subject design to three different binge drinking videos (plus a control group). These videos (available at https://osf.io/2u839/ with English subtitles), realized with the help of high school students in France (for acting, scripting, and procedure) and a professional video company (B Production), depict a young man binge drinking during a social gathering. In every video, two girls are making a comment about the misconducts of the young men (“he cannot control himself” in the cognitive video or “is this dude really my boyfriend?” in the sexual one). The videos are the same and differ only by the results the day after the party. In the cognitive video, the young man wakes up hungover and cannot concentrate to study for his exam (followed by a short message on the cognitive risks of binge drinking). The sexual spot ends on the same individual describing his sexual impotence as his girlfriend is about to leave (followed by a short message on the sexual risk of binge drinking). Finally, the long-term risk video described the young man looking at his future self under perfusion (followed by a message on alcohol toxicity for digestive organs and heart functions). After the video, participants had to evaluate a situation (picture) describing either a man heavily drinking during a casual date (for women participants) or during a drinking competition (men participants). The control group did not see any video and directly received the picture to evaluate.

Study 1

Participants

From September to December 2017, 260 participants entered an online survey they had access to through social networking sites (e.g., Facebook) on student groups or snowball sampling (the link randomly directed them to one of the four conditions of the study). We then excluded participants under 18 or older than 35 who never drank alcohol nor passed the seriousness check and ended up with 77 French men (M = 23.88 years old,
standard deviations \( SD = 4.76 \) and 100 French women \((M = 23.01 \text{ years old}, \ SD = 5.01)\) participants. They had to describe how many drinks they usually consume on a single occasion \((M = 2.68, \ SD = 1.38)\), how many times they had been drunk in their lifetime \((42.94\% \text{ of participants had been drunk more than 10 times and } 10.17\% \text{ had never been drunk})\), and in the last 30 days \((4.52\% \text{ had been drunk at least 4 times and } 58.76\% \text{ had never been drunk})\). Men reported drinking on average three alcoholic drinks per occasion \((M = 3.04, \ SD = 1.34)\) whereas women reported between two and three drinks per event \((M = 2.41, \ SD = 1.35)\). After viewing one of the three videos (sexual, cognitive, long-term disease) or the control page (no video), they had to answer about a situation of a man tolerating alcohol in a dating context (for women participants, see Figure A1 in Appendix) or in a drinking competition (for men participants, see Figure A2 in Appendix).

### Measures

Shortly after the video, all participants had to describe what they just viewed (control check). Then, male participants had to evaluate the picture of a man playing a drinking competition against another man and report how much they agreed with the statement: “You would like to be in Nicolas’s situation” \((1 = \text{completely disagree to } 7 = \text{completely agree}, \ M = 4.29, \ SD = 1.82)\). They also had to evaluate how competitive the target described in the video is (“You would be willing to play with Nicolas in a sport competition”) and the counter-item “If necessary, you would be willing to fight against Nicolas in a sport competition”). Since these measures revealed high internal consistency, they have thus been used in a unique measure \((\alpha = .80, \ M = 4.75, \ SD = 1.64)\).

On the other hand, women participants received a picture describing a man and a woman having a casual date after the man had several glasses of alcohol (whisky). Female participants also had to describe their willingness to be in the drinker’s situation \((M = 2.63, \ SD = 1.46)\). However, the reproductive success measures revealed poor internal consistency for the women sample, and thus, the two measures were treated separately (“Manon finally falls for Nicolas,” \(M = 4.01, \ SD = 1.71\); and “The man drinking is pretty attractive,” \(M = 2.64, \ SD = 1.55\), on a scale from \(1 = \text{completely disagree to } 7 = \text{completely agree}, \alpha = .48\)).

### Results

#### Situation Embodiments (All) and Intrasexual Competition (Men Only)

We systematically applied contrasts to compare the effect of the sexual video to the three other conditions (cognitive vs. long term vs. control) while controlling for the sexual versus cognitive and the sexual versus control comparisons (Brauer & McClelland, 2005) and excluded any outliers. Neither men nor women participants were less willing to be in Nicolas’s state after the sexual videos \((M = 4.27, \ SD = 1.82 \text{ vs. } M = 4.32, \ SD = 1.86)\) when compared to the other videos as revealed by a one-way analyses of variances (ANOVAs; \(p = .79 \text{ and .89, respectively}\). Similarly, the intrasexual competition measurement (combining the will to be in Nicolas’s team as well as how much participants would be willing to play against him in a sport competition) did not reveal any difference after being exposed to the sexual message \((M = 3.96, \ SD = 0.80)\) when compared to the other conditions \((M = 3.89, \ SD = 0.49, p = .91, \text{see Table 1})\).

#### Reproductive Success and Attractiveness (Women Only)

Whereas women did not evaluate differently the reproductive success of the target \((p = .24)\), we observed a statistical trend with Nicolas being evaluated as marginally less attractive after viewing the sexual spot \((M = 2.32, \ SD = 1.49)\) when compared to participants exposed to the cognitive, long-term, and control conditions \((M = 2.73, \ SD = 1.56), t(96) = 1.79, p = .08, 95\% CI [−.01, .19], \eta^2_p = .06 \text{ (see Table 1). There was no interaction between the experimental condition and the actual alcohol consumption of the participant (i.e., 0 = none to less than one drink, 1 = one drink, 2 = two drinks, 3 = three drinks, 4 = four drinks, 5 = five drinks or more, } p = .78)\).

When using contrasts to compare the short- versus long-term conditions (sexual and cognitive spots vs. long-term video and control), women also tended to find Nicolas particularly less attractive after viewing the short-term clips (sexual and cognitive, \(M = 2.67, \ SD = 1.77\)) when compared to the long-term disease video \((M = 3.29, \ SD = 1.35), t(96) = 2.46, p = .02, 95\% CI [−.01, .19], \eta^2_p = .06 \text{ (see Table 2). Again, no interaction emerged when plotting our experimental condition against participants’ self-reported alcohol consumption in a two-way ANOVA interaction } (p = .62)\).

### Table 1. Means (M), and Standard Deviations (SD), of the Different Dependent Variables Across the Different Conditions in Study 1 for the First Hypothesis (Sexual Condition vs. Others).

| Measures/Conditions                          | Sexual (M, SD) | Cognitive (M, SD) | Long-Term Diseases (M, SD) | Control (M, SD) |
|---------------------------------------------|---------------|------------------|---------------------------|----------------|
| Willingness to be in the target’s situation (men) | 4.32 (1.86)   | 4.25 (1.77)      | 4.40 (1.76)               | 4.21 (1.96)    |
| Willingness to be in the target’s situation (women) | 3.89 (0.49)   | 3.66 (0.70)      | 3.93 (0.56)               | 4.19 (0.94)    |
| Target’s reproductive success (women)       | 2.82 (1.68)   | 2.21 (1.12)      | 2.62 (1.56)               | 2.67 (1.41)    |
| Target’s attractiveness (women)             | 2.32 (1.49)   | 3.21 (2.08)      | 3.29 (1.35)               | 2.30 (1.35)    |

-SEX, COG, LTH, CTR
Discussion

This study aimed at testing the effect of different binge drinking messages in videos through an online protocol using social networking sites. For the male sample, the analysis did not reveal any significant difference on the willingness to be in the target’s situation or regarding his competitiveness. However, the results were very interesting with the female sample. For instance, while the evaluation of reproductive success did not differ after viewing the different videos, a marginal effect emerged upon Nicolas’s attractiveness. Women tended to find him less attractive after viewing the sexual video, when compared to the other ones (even though they found him significantly less attractive in the control conditions). Similarly, women tended to find the individual in the dating situation less attractive after viewing the short-term risk videos (sexual and cognitive) compared to the long-term risk one. Participants’ actual level of alcohol consumption did not interact with our main hypothesis, indicating that the spot manipulation is probably the main causal explanation. It seems interesting to note that our manipulation only affected evaluations of women participants but not men (suggesting that those signals are primarily intersexually oriented). To ensure that videos had an attitudinal impact beyond cultural variations and to replicate this gender-biased effect, we conducted a second preregistered online study (van’t Veer & Giner-Sorolla, 2016; Zwaan et al., 2018) in a collectivist society (Peru) after dubbing the videos in Spanish.

Study 2

Participants

Between October 2018 and January 2019, 424 Peruvians participated in a preregistered conceptual replication of Study 1 (http://aspredicted.org/blind.php?x=k6opb4; the manipulation variable stayed the same, but the alcohol measures differed to be more systematic; we also varied the dependent variables (DVS) so they could be more specifics). The different videos were dubbed in Spanish with the help from students of the University of Lima (Peru). After applying exclusion criteria (same as Study 1), 176 participants remained in the final sample (82 women, M = 24.63 years old, SD = 4.80; and 94 men, M = 26.46 years old, SD = 4.58).

Measures

We updated the dependent variables in order to test differences in short- versus long-term evaluations of the target (as binge drinking tolerance could be attractive only for short-term mating). Women evaluated the masculine target on his attractiveness and short- and long-term reproductive success, and score difference was computed (“Maria could get involved in a long-term relationship with José” minus “Maria could get involved in a short-term relationship with José” from 1 = completely disagree to 7 = completely agree, α = .56). On the other hand, we created context-specific intrasexual competition measures as general competitive measure may not be suitable in binge drinking context. Male participants had to evaluate the target’s competitiveness (“How many push-ups could José do?” “How fast could José run a 100 m in seconds?”) were open questions and were treated separately, α = -.18. Both women and men participants indicated a normal use of alcohol beverages through the Alcohol Use Disorders Identification Test- Converse (M = 1.92, SD = 1.08 for men and M = 1.60, SD = 0.70 for women). A score below three is generally considered as low risk for alcoholism (Bush et al., 1998).

Results

Women did not seem to evaluate as more sexually successful or attractive the masculine target after viewing the sexual message video compared to the other spot (p = .61 and p = .27, respectively). However, a positive marginal effect emerged when comparing the sexual to the cognitive spot for attractiveness. We observed a statistical trend with women evaluating the binge drinker as marginally less attractive after viewing the sexual spot (M = 3.95, SD = 1.64) when compared to the cognitive spot (M = 4.13, SD = 1.74), t(77) = 1.79, p = .08, 95% CI [−.02, .21], ηp2 = .06 (see Table 3).

When comparing the short-term risks versus long-term risk videos on the same DVs, the results did not come out significant either (p = .57 and p = .56, respectively). On the other hand, men did not evaluate the target as being able to do more push-ups (p = .66) or slower at running a 100 m (p = .21) after viewing the sexual spot compared to the other ones (p = .63 and p = .17 when comparing short- vs. long-term risks videos, respectively, see Table 4 for all means and SD).

Discussion

In the second study, we ran a conceptual replication of Study 1 in a nonoccidental culture. Using social networking sites, we recruited Peruvian participants to assure that our experimental manipulation had an effect beyond cultural variations. While we

| Measures/Conditions                      | Short-Term Risks | Long-Term Risks | Control |
|-----------------------------------------|------------------|-----------------|---------|
| Willingness to be in the target’s situation (men) | 4.29 (1.80)      | 4.40 (1.76)     | 4.21 (1.96) |
| Intrasexual competition (men)           | 3.79 (0.59)      | 3.93 (0.56)     | 4.19 (0.94) |
| Willingness to be in the target’s situation (women) | 2.58 (1.50)      | 2.62 (1.56)     | 2.67 (1.41) |
| Target’s attractiveness (women)         | 2.67 (1.77)      | 3.29 (1.35)     | 2.30 (1.35) |

Table 2. Means (M) and Standard Deviations (SD), of the Different Dependent Variables Across the Different Conditions in Study 1 for the Second Hypothesis (Short- vs. Long-Term Risks).
were unable to replicate the main findings of Study 1, the study revealed a marginal effect of the sexual spot when compared to the cognitive one on the attractiveness measure (which indicates that there might be differential effects of the signals even among a Peruvian sample). It is possible that the actor (French) had been recognized as not Peruvian (or even as not Latino), provoking a positive cultural contrast that would have annihilated any differential effect of the spot. Another explanation would be that the Peruvian society, not being as much impacted by the binge drinking phenomenon as Europe, might not be sensitive to any of the binge drinking messages. Further studies should try to adapt binge drinking messages to cultural context while controlling for a standard prevention program procedure.

### General Discussion

Why does youth engage much more in binge drinking than adults and how to prevent that phenomenon from expanding? While several cognitive (Oei & Morawska, 2004) and social theories have investigated the causal pathways of such behavior (Durkin et al., 1999; Gibson et al., 2004; Johnston & White, 2003), to our knowledge, no evolutionary theory has been used to build a prevention program against binge drinking. Based on the costly signal theory (Zahavi, 1975; Zahavi & Zahavi, 1999), we postulated that men tolerating alcohol sent signals to both potential mates and other male competitors. By doing so, they display their genetic quality to others, publicly exposing their body to toxic substances and health consequences.

To counter these evolutionary signals, we proposed to send risk signals at play while drinking heavily: sexual impotence, cognitive impairment, and long-term risks. By differentiating those signals, we predicted that the sexual signals sent to young adults at the peak of their sexual life, should be the most impactful. On the other hand, short-term impairments (sexual and cognitive) may also be a competitive hypothesis that blurs the signal sent to mates and male competitors. Through two online closed studies in France and Peru (Studies 1 and 2, respectively), we aimed at investigating whether different types of signals at play in binge drinking videos could influence a later evaluation of an intoxication situation (an impression formation task).

In Study 1, French women tended to marginally downgrade attractiveness of the binge drinker after viewing the sexual spot when compared to the other spots. Surprisingly, the effect was more salient when comparing short-term risk videos (sexual and cognitive) to the long-term one or to the control group. This would indicate that for relatively young adults (18–35 years old), short-term risks may impact even more impression formations than a specific sexual dysfunction signal. To ensure the reliability of that assumption, we ran a preregistered replication of the study in Peru to test whether the cultural context would affect the results. We indeed found that we were not able to replicate the short- versus long-term effects of the video. However, one of our contrasting conditions indicates a marginal difference when comparing the sexual spot to the cognitive one. This suggests that Peruvian participants also encoded the signals sent in the binge drinking videos differently but are sensitive to more specific short-term signal comparisons. This may indicate that countries with faster life-history strategies could be more sensitive to specific signals. Replicating those findings could help explain demographic variation in binge drinking patterns (Hill & Chow, 2002).

### Limitations

As in any research program, our studies had limitations that must contribute to making further studies even more precise to

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**Table 3.** Means (M) and Standards Deviations (SD) of the Different Dependent Variables Across the Different Conditions in Study 2 for the First Hypothesis (Sexual Condition vs. Others).

| Measures/Conditions                  | Sexual Conditions (M) (SD) | Cognitive Conditions (M) (SD) | Long-Term Diseases (M) (SD) | Control (M) (SD) |
|-------------------------------------|---------------------------|-----------------------------|-----------------------------|-----------------|
| Numbers of push-ups (men)           | 46.93 (180.62)            | 19.22 (35.97)               | 19.85 (28.29)               | 14.30 (10.51)   |
| Hundred meters in seconds (men)     | 114.19 (203.46)           | 153.19 (234.22)             | 119.17 (237.37)             | 386.43 (650.52) |
| Target’s reproductive success (women)| −0.55 (1.57)             | −0.84 (1.78)                | −0.89 (2.62)                | −0.40 (2.95)    |
| Target’s attractiveness (women)     | 3.95 (1.64)               | 4.13 (1.74)                 | 5.00 (1.67)                 | 5.40 (1.65)     |

**Table 4.** Means (M) and Standards Deviations (SD) of the Different Dependent Variables Across the Different Conditions in Study 2 for the Second Hypothesis (Short- vs. Long-Term Risks).

| Measures/Conditions | Short-Term Risks (M) (SD) | Long-Term Risks (M) (SD) | Control (M) (SD) |
|---------------------|---------------------------|--------------------------|-----------------|
| Numbers of push-ups (men) | 31.63 (123.43)             | 19.85 (28.29)             | 14.30 (10.51)   |
| Hundred meters in seconds (men) | 136.32 (219.34)           | 119.17 (237.37)           | 263.08 (504.26) |
| Target’s reproductive success (women) | −0.73 (1.69)            | −0.89 (2.62)               | −0.72 (2.70)    |
| Target’s attractiveness (women)     | 4.06 (1.69)               | 5.00 (1.67)                | 5.14 (1.64)     |
attest transparency and replicability. First, since some of the students of that particular high school participated as actors in our binge drinking spots, it was ethically impossible to ask participants to evaluate them. This goes against both research ethical standards and appropriate academic education cooperation. As a result, we had to create an impression formation task following the diffusion of our spots, making the transfer of sexual and competitive evaluation much more difficult to evaluate that if we would have asked to judge directly the individual acting in the different videos. On the other hand, it can be a way to sidestep eventual experimental biases by transferring the spot influences over another task as it is common in social psychology.

Additionally, we did not test for the impact of the spot on attitude or consumption toward alcohol. We tested an indirect impression formation task after the exposure to a spot. The main interest here was to see how binge drinking signals could impact the way they judge an intoxicated peer during a social gathering. Showing that specific signals impact more their impressions than others could be of great help for the health and educational community and contribute more deeply to understand binge drinking as a multifaceted phenomenon.

The main replication of this project may target young high school or university students outside of scholar context to see how much of the cognitive versus sexual signaling really impacts their impression formation. One way to replicate this program would be a longitudinal online investigation to see right after, +1 week, and +1 month after this exposure how much the different spots impacted their attitude toward alcohol and how robust and strong the effect is. Another advantage of the online protocol is that, contrary to a classroom where data can get really noisy (student–student interactions, professor presence, scholar environment, etc.), the online version can be made isolated at home, similarly to the way they would be talking to their friend online or planning a social event.

On the other hand, doing a laboratory setting of our experiment, adding implicit or physiological measures, might be a good way to correlate self-report postimpression to direct in vivo implicit reactions and physiological changes. First, an eye-tracker study would permit to see which part of the different spots attract the most student’s attention, and pupil dilation would tell which moment is most impactful (either describing fear or excitement). Moreover, adding electromyography measures to evaluate electrical activity produced by skeletal muscles (Weiss et al., 2015) and distinguish, combined with eye-tracking measures, which part of the videos are the most stressful could help develop future health programs that are both impactful and measurable. Evidence-based policy must be evaluated scientifically on the long term and, like any other bottom-up approach, health programs must always be turned to measurable hypothesis-generating studies.

The literature is also inconsistent about whether impression formation tasks can in fact reduce drinking intentions. Public health researchers used framing effects (from the prospect theory, Kahneman & Tversky, 2013) to show that a loss-framed message (e.g., engaging in binge drinking ruins your health) would tend to increase risky drinking when compared to a gain-framed one (e.g., refraining from binge drinking is good for you). Gerend and Cullen (2008) were the first to experimentally test (in laboratory conditions) the effect of framed messages on quantity of alcohol use. Participants exposed to short-term consequences messages reported fewer drinks per drinking occasion when compared to participants exposed to long-term consequences messages. They also found that participants in the short-term conditions decreased their drinking consumption after being exposed to gain-framed messages compared to participants in the loss-framed condition. However, Bernstein and colleagues (2015) found that in the loss-framed condition, participants actually reported fewer heavy episode drinking (HED) compared to the gain-framed condition (though they found a main effect of short-term consequences messages on reducing HED compared to long-term consequences messages). On the other hand, Hutter and colleagues (2015) found no main effects in a large sample of UK students (N = 666). They reported that gain-framed messages with incongruous pairing (i.e., loss/refrain or gain/engage) decreased alcohol consumption 2 weeks later compared to other combinations. Our study was the first to propose an impression formation of binge drinker in short- versus long-term consequences messages. Yet, our messages are only loss-framed, and thus, a gain versus loss-framed manipulation should be compared to test how the framing interacts with the impression formation.

Our data suggest a gender difference with women being more influenced by the different conditions (the message videos) when compared to men participants. This can be the result of different operationalizations across genders (intersexual measures for women and intrasexual competition ones for men). However, a meta-analysis conducted by Tannenbaum and colleagues (2015) suggests that, for instance, fear appeals are more efficient when targeting a larger female audience. According to the regulatory fit theory (Higgins et al., 2008), people can be promotion or prevention focused. Our videos end with a prevention message focusing on specific health risks of binge drinking and so are definitely prevention-based messages. Past research indicated that women are more prevention focused than men (Kurman & Hui, 2011; Lockwood et al., 2005), possibly explaining the gender gap we found in the different studies.

Finally, further research should include impression formation tasks including men tolerating alcohol’s effect to see how the influence of the different signaling may vary the response to the following task. Indeed, one possible weakness in our spots is that the men not tolerant to alcohol are sending, de facto, signals of low genetic quality to the participants. To that extent, possible floor effects could have emerged making the target (Nicolas) unfit whatever the situation following the spot is. Getting short- or long-term signals, sexual, or nonsexual would in that case make no difference whatsoever about the target’s capability. On the contrary, measuring the transfer of those signals upon a tolerant man would probably show higher variations between spots leading to more subtle measurements.
Conclusion

In two innovative studies, we exposed participants from France (Study 1) and Peru (Study 2) in between-subject design to three binge drinking videos describing either sexual (i.e., impotence), cognitive (i.e., memory loss), or long-term risks (e.g., cancer/cardiovascular diseases). Overall, we found that women participants exposed to the video describing sexual impotence tended to downgrade the attractiveness evaluation of the binge drinker in a subsequent task. However, male participants did not seem impacted by the different risk signaling of the videos. Future studies should control for the sex of the target as well as for the signal being send (alcohol tolerance vs. intolerance). These results shed light on possible evolutionary mechanisms that could help us understand impression formation in binge drinking contexts.

Appendix

Figure A1. Picture displayed after the clip for women participants.

Figure A2. Picture displayed after the clip for men participants.

Authors’ Note

IDIC’s ethical committee gave its content for Study 2.

Declaration of Conflicting Interests

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Notes

1. This is representative of the prevalence of binge drinking in the past 30 days found in adolescents and young adults (see Chung et al., 2018). However, to ensure that this did not influence our results, we systematically controlled for the effect of being drunk in the last 30 days (dummy coding).

2. We checked in every analysis for potential statistical outliers following the studentized deleted residual technics indicating that a level greater than 4 is consider as outliers (see McClelland, 2014). When no additional information was added, this meant the results remained the same with or without outliers.

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