Psychology of Addictive Behaviors

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BRIEF REPORT

# Problematic Social Media Use Is Associated With Increased Risk-Aversion After Negative Outcomes in the Balloon Analogue Risk Task

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Around the world, people display maladaptive, problematic use of online social networking sites (SNSs), like Facebook, Snapchat, and Instagram. The symptoms of this problematic SNS use are similar to symptoms of substance use and behavioral addictive disorders, such as relapse when attempting to quit. Individuals with substance use and behavioral addictive disorders also display increased risk-taking when making decisions, but little research has investigated decision making with respect to problematic SNS use. We therefore assessed risky decision making and problematic SNS use by utilizing the Balloon Analogue Risk Task (BART). In line with previous research on behavioral addictive disorders, we hypothesized that greater problematic SNS use would be linked with greater risk-taking. To address our hypothesis, we conducted three studies in which we administered the Bergen Social Media Addiction Scale to assess problematic SNS use and related scores to BART performance. Collectively, and counter to our initial hypothesis, we found a negative association between problematic SNS use and risk-taking. Specifically, the more problematic one's SNS use, the less risk they took, but this risk aversion only occurred after receiving negative feedback on previous decisions and then encountering a situation with less actual risk. Implications of this novel finding are discussed.

*Keywords:* social media, social networking sites, addiction, decision making, risk



Almost three billion people worldwide use online social networking sites (SNSs) like Facebook, Instagram, and Snapchat (Statista, 2019). These platforms provide social rewards that act as reinforcers, bringing people back to these SNSs repeatedly, and for substantial durations of time (Meshi, Tamir, & Heekeren, 2015). Importantly however, in some individuals, these social reinforcers may evoke SNS use that is maladaptive and problematic (Griffiths, Kuss, & Demetrovics, 2014). Problematic SNS users encounter negative outcomes (e.g., job loss), and display impairment in daily functioning and symptoms that mirror substance use disorders—which in some cases leads to clinical treatment (Griffiths et al., 2014; Karaiskos, Tzavellas, Balta, & Paparrigopoulos, 2010).

The repeated use of SNSs in the face of negative outcomes indicates that problematic SNS users may possess aberrations in their cognitive, decision-making processes. An initial study with the Iowa Gambling Task (IGT) supports this, revealing that the more problematic one's SNS use, the worse one does in the task (Meshi, Elizarova, Bender, & Verdejo-Garcia, 2019). Poor task performance can be interpreted as the result of greater risk-taking, but the IGT is a complex paradigm that involves a variety of decision-making components (Verdejo-Garcia, Chong, Stout, Yücel, & London, 2018). Therefore, further research specifically addressing the relationship between risky decision making and problematic SNS use is required.

To specifically investigate risky decision making, researchers have developed the Balloon Analogue Risk Task (BART; Koffarnus & Kaplan, 2018; Lejuez et al., 2002). Previous studies with the

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The data and narrative interpretations of the data/research presented in this article have not been previously disseminated. We thank Rui Pei and Antonio Verdejo-Garcia for comments on previous versions of this article. We replicated these analyses using regression across all three studies; results are available here: https://osf.io/v6kum/?view_only=8797f851c68541ac91409cf8b7d6f0e3.

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BART revealed that individuals dependent on substances, such as heroin, crack cocaine, marijuana, alcohol, and nicotine, display a propensity toward risk taking (Bornovalova, Daughters, Hernandez, Richards, & Lejuez, 2005; Fernie, Cole, Goudie, & Field, 2010; Hanson, Thayer, & Tapert, 2014; Lejuez et al., 2003). No study has yet investigated, however, if problematic SNS users display greater risk-taking propensity in the BART. We therefore used the BART to expand on previous decision-making research with the IGT, and we examined individual differences in BART performance with respect to problematic SNS use. We hypothesized that problematic SNS users would display increased risk-taking, in line with previous research (Meshi et al., 2019).

## Study 1

### Method

**Participants.** Students from a large Midwestern U.S. university participated for course credit. The sample size consisted of 105 participants, after excluding four individuals due to technical problems during the experiment. For demographic characteristics, please see Table 1.

**Problematic social media use.** The Bergen Social Media Addiction Scale (BSMAS; Andreassen, Torsheim, Brunborg, & Pallesen, 2012; Bányai et al., 2017) assessed problematic SNS use. The BSMAS consists of six items rated on a 5-point Likert scale (1 = *very rarely*; 5 = *very often*), and we summed responses. Each BSMAS item assesses a core aspect of addiction: salience, mood modification, tolerance, conflict, withdrawal, and relapse (Griffiths et al., 2014). Reliability and validity of the BSMAS have been established (Bányai et al., 2017), and the internal consistency with our sample was good (Cronbach's alpha = .88). See Table 2 for descriptive statistics.

**Balloon analogue risk task.** All participants completed a computer-based BART programmed in the Psychology Experiment Building Language software (PEBL2; Mueller, 2012). In each trial, participants were presented with a colored balloon. Participants could select one of two options on their screen: (1) pressing a button to inflate the balloon and earn $0.05 of play money, or (2) pressing a button to end the trial and collect the accumulated play money. Participants were instructed to obtain the greatest amount of play money possible, and they were free to inflate the balloon as many times as they wanted—the size of the balloon increased with each button press. Participants experienced decisions under risk because the balloon could pop, and if the balloon popped, participants forfeited their accumulated play money for the trial. The trial ended when either the balloon popped or the participant collected the play money.

In Study 1, all participants experienced 90 trials of the BART: 30 orange balloons, 30 yellow balloons, and 30 blue balloons presented in a random order for each participant. Unbeknownst to the participants, each color balloon had a different probability of exploding; orange balloons averaged 4 pumps (ranging from 1 to 8), yellow balloons averaged 16 pumps (ranging from 1 to 32), and blue balloons averaged 64 pumps (ranging from 1 to 128). Based on previous research (Koffarnus & Kaplan, 2018), three measures were used in analyses (see Table 2): (1) mean adjusted pumps: average inflation pumps on each trial in which a balloon did not burst, for each color balloon condition; (2) total balloons burst: sum of the exploded balloons for each color; and (3) total money earned: sum of the dollars collected for each color.

**Procedure.** Study procedures were approved by the university Institutional Review Board. Participants were seated in front of a computer. After giving consent, participants completed the BART and then took a survey that recorded problematic SNS use and

Table 1
*Summary of Demographic Characteristics Across All Three Studies*

| Variables | Study 1 ($N$ = 105) | Study 2 ($N$ = 101) | Study 3 ($N$ = 123) |
|---|---|---|---|
| Age | 20.8 (1.4) | 20.3 (1.4) | 20.7 (1.5) |
| Gender | | | |
| Female | 56 (53.3%) | 73 (72.3%) | 65 (52.8%) |
| Male | 49 (46.7%) | 28 (27.7%) | 58 (47.2%) |
| Race | | | |
| White | 70 (66.7%) | 70 (69.3%) | 85 (69.1%) |
| Asian or Pacific Islander | 20 (19.1%) | 23 (22.8%) | 20 (16.3%) |
| Black or African American | 10 (9.5%) | 5 (5.0%) | 14 (11.4%) |
| American Indian/Alaskan Native | 0 (0.0%) | 0 (0.0%) | 1 (0.8%) |
| Other/Prefer not to answer | 5 (5.8%) | 3 (3.0%) | 3 (2.4%) |
| Ethnicity | | | |
| Non-Hispanic/Latino | 101 (96.2%) | 85 (84.2%) | 101 (82.1%) |
| Hispanic/Latino | 4 (3.8%) | 9 (8.9%) | 5 (4.1%) |
| Other/Prefer not to answer | 0 (0.0%) | 7 (6.9%) | 17 (13.8%) |
| GPA | 3.27 (0.49) | 3.37 (0.45) | 3.28 (0.44) |
| Household Annual Income | | | |
| Under $30,000 | n/a | 12 (11.9%) | 13 (10.6%) |
| $30,000–$49,999 | n/a | 8 (7.9%) | 12 (9.8%) |
| $50,000–$74,999 | n/a | 11 (10.9%) | 13 (10.6%) |
| $75,000–$99,000 | n/a | 18 (17.8%) | 24 (19.5%) |
| $100,000 or more | n/a | 52 (51.5%) | 61 (49.6%) |

*Note.* Data reported as $M$ ($SD$) or $N$ (%).

Table 2
*Summary of Problematic Social Media Use and BART Performance Reported as Means (SD) and Totals Across All Three Studies*

| Variables | Study 1 | Study 2 | Study 3 |
|---|---|---|---|
| Problematic Social Media Use | 14.8 (5.8) | 14.7 (4.4) | 15.4 (4.9) |
| Score range (min to max) | 6 to 30 | 6 to 30 | 7 to 30 |
| BART | | | |
| Total balloons per participant | 90 | 30 | 60 |
| Mean adjusted pumps: Orange | 2.5 (1.2) | n/a | 2.5 (0.9) |
| Mean adjusted pumps: Yellow | 7.9 (3.3) | n/a | n/a |
| Mean adjusted pumps: Blue | 16.8 (11.5) | 31.1 (12.7) | 26.5 (14.9) |
| Mean adjusted pumps: All | 11.7 (6.7) | 31.4 (12.7) | 17.2 (9.0) |
| Total burst balloons: Orange | 22.1 (5.5) | n/a | 16.5 (4.4) |
| Total burst balloons: Yellow | 10.9 (5.2) | n/a | n/a |
| Total burst balloons: Blue | 4.9 (3.9) | 8.6 (3.7) | 7.8 (4.3) |
| Total burst balloons: All | 37.8 (11.9) | 8.6 (3.7) | 24.3 (7.0) |
| Total earned: Orange | 1.0 (0.6) | n/a | 1.6 (0.4) |
| Total earned: Yellow | 6.9 (2.0) | n/a | n/a |
| Total earned: Blue | 19.2 (10.0) | 31.2 (8.9) | 26.8 (11.2) |
| Total earned: All | 27.0 (10.3) | 31.2 (8.9) | 28.3 (11.1) |

*Note*. Total earned reported in dollars. BART = Balloon Analogue Risk Task.

demographics (age, gender, race/ethnicity, and estimated grade point average).

**Data analysis.** All analyses were performed with SPSS software (IBM Inc., Version 25, Armonk, New York). We used zero-order Pearson product–moment correlations to conduct initial comparisons among all variables (problematic social media use, task behaviors, and demographic variables; gender was coded as male = 0 and female = 1). We then computed second-order Pearson product–moment partial correlations while controlling for both age and gender.

## Results

We first examined potentially relevant demographic variables for significant correlations with our factors of interest. Our analyses revealed a significant correlation between age and mean adjusted pumps for orange balloons, $r = -.32$, $p < .01$, as well as a significant correlation between gender and total amount earned for yellow balloons, $r = .20$, $p < .04$. All other correlations were nonsignificant ($ps > .05$). To then address our hypothesis, we conducted second-order partial correlations between problematic SNS use and BART performance measures while controlling for age and gender (see Table 3, Study 1). Counter to our initial hypothesis, our analyses revealed significant negative associations between problematic SNS use and our three measures of risk-taking when combining across all colored balloons. Our analyses also revealed a trend with respect to balloon color: The relationship between problematic SNS use and decision making for our three BART measures was only present for the low-risk blue balloons (all three measures) and the middle-risk yellow balloons (two of three measures). The relationship was absent for the high-risk orange balloons (none of the measures).

## Discussion

In contrast to our initial hypothesis, greater problematic SNS use was associated with more conservative decision making under risk. These associations appeared only with balloons that allow more relative inflation attempts, the blue and yellow balloons. Our results run counter to research on degree of problematic SNS use with the IGT (Meshi et al., 2019), as well as the majority of previous work with the BART and substance use disorders. In revisiting the previous BART literature, we realized that some studies with significant results only used blue balloons with an average burst point of 64 pumps, forgoing the other colors (Bornovalova et al., 2005; Canavan, Forselius, Bessette, & Morgan, 2014; Crowley, Raymond, Mikulich-Gilbertson, Thompson, & Lejuez, 2006; Fernie et al., 2010; Hanson et al., 2014). Study 2 therefore uses only blue balloons to more precisely emulate these previous studies.

# Study 2

## Method

The methods for Study 2 were almost identical to Study 1, and no one assessed in the previous study was allowed to participate.

Table 3
*Second-Order Pearson Partial Correlations Between Problematic Social Media Use and BART Performance, Controlled by Age and Gender, Across All Three Studies*

| Variables | Study 1 BSMAS | Study 2 BSMAS | Study 3 BSMAS |
|---|---|---|---|
| Mean adjusted pumps: Orange | .02 [−.16, .19] | n/a | .00 [−.15, .16] |
| Mean adjusted pumps: Yellow | −.22* [−.37, −.07] | n/a | n/a |
| Mean adjusted pumps: Blue | −.24* [−.41, −.05] | .06 [−.12, .24] | −.19* [−.36, −.01] |
| Mean adjusted pumps: All | −.29** [−.44, −.11] | .06 [−.12, .24] | −.20* [−.36, −.04] |
| Total burst balloons: Orange | −.19 [−.34, −.01] | n/a | −.04 [−.22, .14] |
| Total burst balloons: Yellow | −.31** [−.46, −.14] | n/a | n/a |
| Total burst balloons: Blue | −.25* [−.40, −.06] | .04 [−.16, .25] | −.15 [−.33, .04] |
| Total burst balloons: All | −.30** [−.43, −.13] | .04 [−.16, .25] | −.11 [−.29, .05] |
| Total earned: Orange | .13 [−.05, .30] | n/a | .06 [−.11, .24] |
| Total earned: Yellow | .03 [−.17, .21] | n/a | n/a |
| Total earned: Blue | −.23* [−.38, −.04] | .08 [−.12, .26] | −.19* [−.36, −.02] |
| Total earned: All | −.21* [−.36, −.02] | .08 [−.12, .26] | −.19* [−.37, −.01] |

*Note*. 95% CI reported in brackets. BSMAS = Bergen Social Media Addiction Scale.
* $p < .05$. ** $p < .01$. *** $p < .001$.

The sample size consisted of 101 participants, after excluding two individuals due to technical problems, two individuals for not reporting gender, and four individuals for not following instructions. We also asked participants to estimate the income in the house they were raised in. We again used the BSMAS to assess problematic SNS use (Cronbach's alpha = .79). Importantly, the BART for Study 2 consisted of only 30 trials with blue balloons (identical burst characteristics as Study 1). See Table 2 for descriptive statistics of BSMAS scores and BART measures.

## Results

We conducted second-order partial correlations between problematic SNS use and BART performance measures while controlling for age and gender (see Table 3, Study 2). Our analyses revealed no significant associations with any measure of risk-taking in the BART.

## Discussion

Study 2 did not replicate Study 1. We theorized that this discrepancy might be due to quick negative feedback from failures with orange balloons near the start of Study 1. To support this, participants in Study 1 burst significantly more, $t = 9.25$, $p < .001$ of their first 10 balloons ($m = 5.14$, $SD = 1.60$) in comparison to participants in Study 2 ($m = 3.09$, $SD = 1.58$). Participants in Study 1 may have generalized their experience with these quicker-bursting balloons (orange) to the other balloon colors (blue and yellow), becoming more risk-averse to the less-risky balloons. In other words, we hypothesized that problematic SNS users may display greater sensitivity to negative outcomes and subsequently display more risk aversion to future situations with less actual risk (e.g., blue balloons). This is based on the significant correlations observed in Study 1 between problematic SNS use and BART measures of risk-taking for the less-risky balloons.

To directly address our "increased risk aversion" hypothesis, we conducted Study 3, in which participants only encountered orange balloons (average burst point of 4 pumps) and blue balloons (average burst point of 64 pumps). Importantly, half our participants first completed a block of 30 orange balloons and then a block of 30 blue balloons (Orange First), while the other half of participants completed a block of 30 blue balloons and then a block of 30 orange balloons (Blue First). We expect three outcomes: (1) Participants in the Orange First group should burst more balloons in the first block of balloons (orange) and fewer balloons in the second block of balloons (blue) than their Blue First group counterparts. This will demonstrate that our manipulation worked because the Orange First group will transition from a high-negative outcome situation to a low-negative outcome situation, while the Blue First group will transition from a low-negative outcome situation to a high-negative outcome situation. (2) Study 3 should replicate Study 1 when analyzed across all participants and combined balloon colors. As in Study 1, this effect should be driven by behavior in the low-risk situation (blue balloons). (3) There will be an interaction effect of group with problematic SNS use, such that the Orange First group should replicate Study 1, while the Blue First group should replicate Study 2. Specifically, the Orange First group will transition from high-risk to low-risk, so we expect to see our hypothesized "increased risk aversion" effect, whereas, the Blue First group will transition from low-risk to high-risk, and the first block of blue balloons will replicate Study 2.

# Study 3

## Method

The methods for Study 3 were almost identical to Studies 1 and 2, and no one assessed in the previous studies was allowed to participate. The sample size consisted of 123 participants, after excluding two individuals due to technical problems, and six individuals for not following instructions. Please see Tables 1 and 4 for demographic characteristics. We again used the BSMAS to assess problematic SNS use (Cronbach's alpha = .80). The BART consisted of 60 trials: 30 orange balloons and 30 blue balloons (identical burst characteristics as Study 1). Balloon color was not random across trials; participants experienced a block of 30 trials of one color, and then a block of 30 trials of the other color. The order of color blocks was counterbalanced across participants, and groups had similar demographics and problematic SNS use (independent-samples $t$ tests of statistics in Table 4 revealed all $p$s $> .1$). See Table 2 for descriptive statistics of BSMAS scores and BART measures. Analyses for Study 3 were similar to Studies 1 and 2. In addition, we also employed the SPSS PROCESS macro (Hayes, 2013) to examine if color block order moderated the relationship between BSMAS (independent variable) and BART measures (dependent variables), while controlling for age and gender.

## Results

To test our first expectation, we conducted independent-samples $t$ tests of burst balloons between groups (see Table 5). Our ma-

Table 4
*Summary of Demographic Characteristics and Problematic Social Media Use Across Condition in Study 3*

| Variables | Blue First ($N = 63$) | Orange First ($N = 60$) |
|---|---|---|
| Age | 20.67 (1.39) | 20.68 (1.67) |
| Gender | | |
| Female | 35 (55.6%) | 30 (50%) |
| Male | 28 (44.4%) | 30 (50%) |
| Race | | |
| White | 42 (66.7%) | 43 (71.7%) |
| Asian or Pacific Islander | 12 (19.1%) | 8 (13.3%) |
| Black or African American | 7 (11.1%) | 7 (11.7%) |
| American Indian/Alaskan Native | 1 (1.6%) | 0 (0%) |
| Other/Prefer not to answer | 1 (1.6%) | 2 (3.3%) |
| Ethnicity | | |
| Non-Hispanic/Latino | 4 (6.4%) | 1 (1.7%) |
| Hispanic/Latino | 47 (75.6%) | 54 (90%) |
| Other/Prefer not to answer | 12 (19.1%) | 5 (8.3%) |
| GPA | 3.24 (0.41) | 3.23 (0.47) |
| Household Annual Income | | |
| Under $30,000 | 8 (12.7%) | 5 (8.3%) |
| $30,000–$49,999 | 7 (11.1%) | 5 (8.3%) |
| $50,000–$74,999 | 7 (11.1%) | 6 (10%) |
| $75,000–$99,000 | 11 (17.5%) | 13 (21.7%) |
| $100,000 or more | 30 (47.6%) | 31 (51.7%) |
| Problematic Social Media Use | 15.71 (5.29) | 15.03 (4.37) |
| Score range (min to max) | 7 to 30 | 7 to 26 |

*Note.* Data reported as $M$ ($SD$) or $N$ (%).

Table 5
*BART Performance Reported as Mean (SD) and t-Test Comparisons Across Condition in Study 3*

| Variables | Blue First ($N = 63$) | Orange First ($N = 60$) | *t*-score | Cohen's *d* |
|---|---|---|---|---|
| Mean adjusted pumps: Orange | 2.1 (0.8) | 2.9 (0.9) | 5.30*** | .96 |
| Mean adjusted pumps: Blue | 31.3 (14.1) | 21.6 (14.1) | −3.80*** | −.69 |
| Mean adjusted pumps: All | 19.1 (8.4) | 15.1 (9.2) | −2.58* | −.46 |
| Total burst balloons: Orange | 15.5 (4.6) | 17.5 (3.8) | 2.55** | .46 |
| Total burst balloons: Blue | 9.1 (4.0) | 6.4 (4.3) | −3.63*** | −.65 |
| Total burst balloons: All | 24.6 (7.2) | 23.9 (6.9) | −0.59 | −.11 |
| Total earned: Orange | 1.4 (0.4) | 1.7 (0.4) | 4.22*** | .76 |
| Total earned: Blue | 30.6 (11.0) | 22.7 (9.9) | −4.19*** | −.76 |
| Total earned: All | 32.0 (11.0) | 24.4 (9.8) | −4.03*** | −.73 |

*Note*. Total earned reported in dollars.
* $p < .05$. ** $p < .01$. *** $p < .001$.

nipulation worked; the Orange First group burst more balloons in the first block of balloons and fewer balloons in the second block of balloons.

To test our second hypothesis, we conducted second-order partial correlations between problematic SNS use and BART performance measures while controlling for age and gender across all participants (see Table 3, Study 3). Similar to Study 1, our analyses with all balloons revealed significant negative associations between problematic SNS use and two of our three BART measures. We expected that these effects in the combined color conditions across all participants would be driven by behavior in the low-risk situation (blue balloons), and indeed, Study 3 replicated the pattern previously observed in Study 1.

To address our third hypothesis, we ran moderation analyses that examined the interaction of problematic social media use and balloon color order on BART performance, with age and gender as covariates (see Table 6). We revealed significant interaction effects in mean adjusted pumps and burst balloons, both with the total measures (including both balloon colors) and specifically with the blue balloons. Of note, age and gender were not significant in any model (all $ps > .05$). Next, we also examined associations between problematic SNS use and BART performance within our two groups separately (see Figure 1). Our analyses with the Orange First group confirmed our hypothesis: In the first block (orange balloons) there was a nonsignificant association, but in the second block (blue balloons), problematic SNS use was negatively associated with all three BART measures. Conversely, no significant associations between problematic SNS use and BART measures of risk-taking were present in the Blue First group. These null findings in the first block (blue balloons) replicated Study 2.

## General Discussion

Three studies collectively demonstrate a negative association between problematic SNS use and risk-taking, but only after individuals receive negative outcomes and then encounter less-risky situations. Study 1 revealed this association because we employed balloons with different risk profiles presented in random order. This caused participants to receive more negative outcomes at the start of the experiment (first 10 trials) than in Study 2. In Study 2, we provided participants with one balloon color with a single, low-risk profile. As a result, participants experienced fewer negative outcomes and we did not observe a significant association between problematic SNS use and risk-taking. We then designed a new paradigm, Study 3, in which participants specifically transitioned from a high-risk to a low-risk situation, and vice versa. Study 3 replicated the effects observed in both Studies 1 and 2,

Table 6
*Moderation Analyses Examining the Interaction of Problematic Social Media Use and Balloon Color Order in Study 3 on BART Performance, Controlled by Age and Gender ($N = 123$)*

| Variables | Point estimates | | Overall model summary | | |
|---|---|---|---|---|---|
| | Blue First | Orange First | F | Adj $R^2$ | Interaction $\Delta R^2$ |
| Mean adjusted pumps: Orange | −.02 [−.07, .03] | .02 [−.02, .06] | 6.61 | .19*** | .01 |
| Mean adjusted pumps: Blue | −.28 [−.94, .39] | −1.33** [−2.18, −.48] | 5.20 | .15*** | .03*+ |
| Mean adjusted pumps: All | −.16 [−.58, .25] | −.85** [−1.38, −.32] | 3.58 | .10** | .03* |
| Total burst balloons: Orange | .10 [−.11, .30] | −.21 [−.48, .05] | 2.26 | .05*† | .03 |
| Total burst balloons: Blue | .004 [−.19, .20] | −.41** [−.66, −.16] | 5.01 | .14*** | .05** |
| Total burst balloons: All | .10 [−.23, .43] | −.06** [−1.05, −.20] | 1.95 | .04 | .06** |
| Total earned: Orange | .02 [−.002, .04] | −.001 [−.02, .02] | 5.71 | .16*** | .02 |
| Total earned: Blue | −.24 [−.73, .25] | −.94** [−1.6, −.31] | 6.09 | .17*** | .02 |
| Total earned: All | −.24 [−.73, .25] | −.92** [−1.6, −.29] | 5.73 | .16*** | .02 |

*Note*. 95% CI reported in brackets. BART = Balloon Analogue Risk Task.
*† $p = .05$. * $p < .05$. ** $p < .01$. *** $p < .001$.

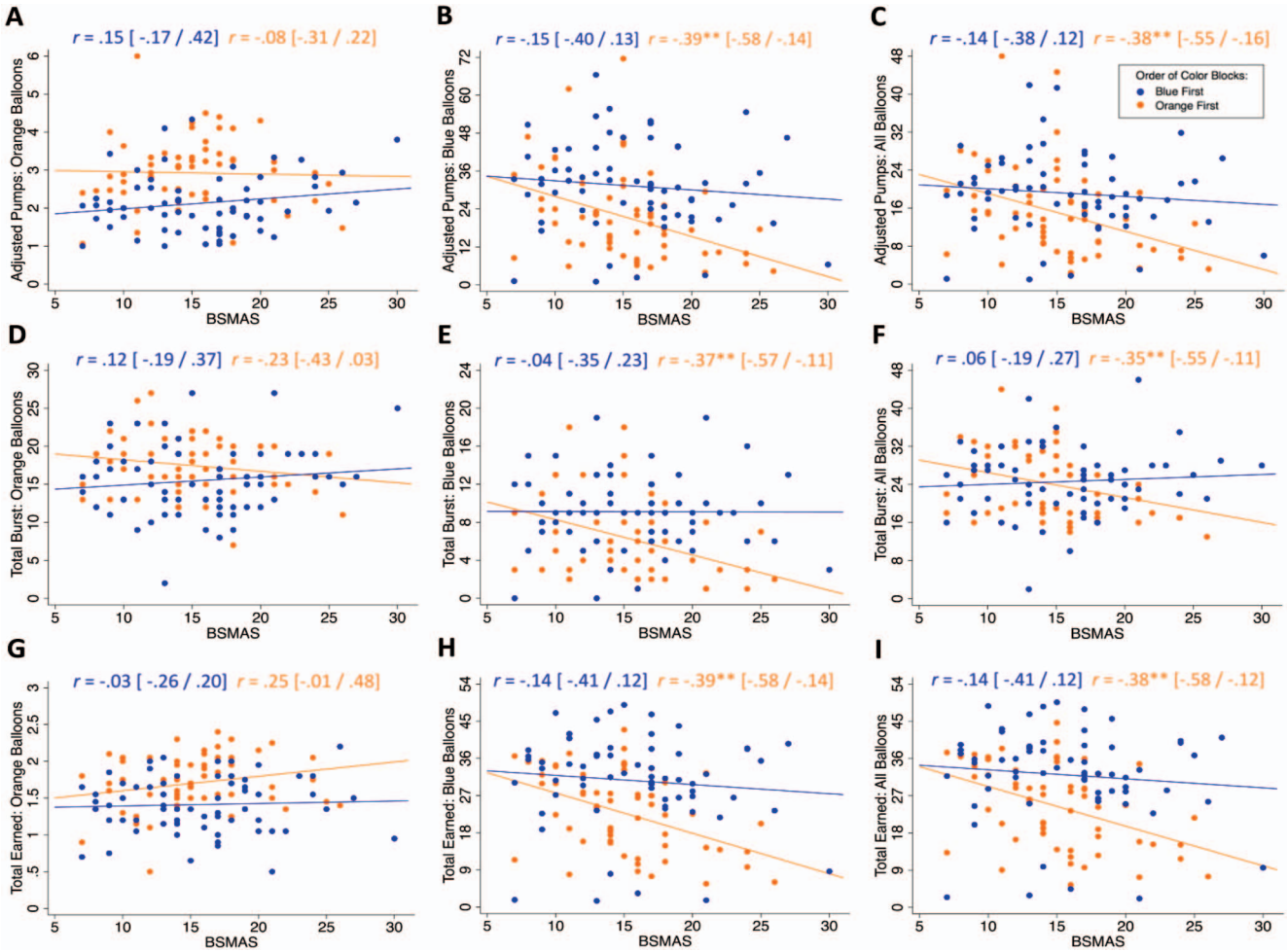


*Figure 1.* Scatterplots of problematic social media use and Balloon Analogue Risk Task (BART) performance for Study 3 with participants grouped by balloon color order (Blue First in blue; Orange First in orange). BART performance presented as mean adjusted pumps for orange balloons (a), blue balloons (b), and all balloons (c); total burst for orange balloons (d), blue balloons (e), and all balloons (f); and total dollars earned for orange balloons (g), blue balloons (h), and all balloons (i). Reported statistics are second-order Pearson partial correlations, controlled for age and gender. $^{*}$ $p < .05$; $^{**}$ $p < .01$; $^{***}$ $p < .001$; 95% CI reported in brackets.

demonstrating that more problematic SNS users become more risk averse after experiencing negative decision outcomes.

Our results run counter to prior research on degree of problematic SNS use with the IGT (Meshi et al., 2019). This discrepancy can be resolved when taking into account the exact nature of what the BART and IGT assess. Verdejo-Garcia and colleagues (2018) described the BART as assessing participant risk evaluation during decision making, while the IGT is more complex, assessing both risk and ambiguity evaluations, as well as various aspects of feedback processing, including reward learning and memory. We therefore used the BART to expand on previous research with the IGT, tapping into a more succinct facet of decision making. Importantly, we only observed an increase in risk aversion when participants transitioned from a high-risk to a low-risk situation. This type of transition doesn't occur in the IGT, nor in a traditional BART paradigm. This type of transition is similar to a probabilistic reversal learning paradigm, where participants learn reward contingencies of two choices and then this learned rule is switched (Swainson et al., 2000). This type of learning has not yet been directly assessed with regard to problematic SNS use, but individuals with substance use disorders display impairments when switching to the new rule (for review, see Izquierdo & Jentsch, 2012). Future research with a probabilistic reversal learning paradigm may elucidate components of decision-making relevant for problematic SNS users.

Our research has limitations that deserve mention. First, in Study 3 we modified the BART in a unique way. The BART has not been validated for use in this way, and interpretation of our findings should be made with caution. Second, our sample size for each study was modest, ranging from 101 to 123 individuals, meaning that power may have been low. Third, the orange balloons require less pumps to explode, inherently resulting in less variance in BART measures. This could be responsible for our lack of significant findings with orange balloons. Fourth, balloon color and balloon risk profile were not counterbalanced across partici-

pants; orange balloons were always high risk and blue balloons were always low risk. It could be that the specific color associated with the risk interacted with our behavioral measures. Finally, the observed associations between problematic SNS use and BART performance may be explained by a third, unmeasured variable affecting both problematic SNS use and BART performance. Future research that includes additional measures of other relevant dimensions, such as mental health (e.g., anxiety) or personality, will be better able to address this issue.

In sum, our findings have various implications for the research field. As mentioned above, future research investigating learning would help us better understand decision making and problematic SNS use. In addition, evaluating risky decision making without a learning component would also be beneficial. To explain, the traditional BART paradigm still has a learning component—participants implicitly learn the burst probability of the blue balloons as they proceed through the trials of the task. Therefore, even the traditional BART doesn't isolate risky decision making from learning. Future research with one-time gamble paradigms without outcome feedback, for example, could potentially avoid this overlap between risk and learning to better assess risk-taking propensity with respect to problematic SNS use. Our research may also have implications for researchers who use the BART to answer questions unrelated to problematic SNS use. Although our BART modification has yet to be validated, researchers investigating other behavioral addictive and substance use disorders can capitalize on our modification to apply the BART in a similar fashion. Furthermore, investigators with previous nonsignificant BART results may want to revisit their work using our adaptation as well. Overall, future application of our novel BART modification may help researchers better understand the decision making of their participants and the clinical populations they investigate.

## References


Andreassen, C. S., Torsheim, T., Brunborg, G. S., & Pallesen, S. (2012). Development of a Facebook Addiction Scale. *Psychological Reports, 110,* 501–517. http://dx.doi.org/10.2466/02.09.18.PR0.110.2.501-517

Bányai, F., Zsila, Á., Király, O., Maraz, A., Elekes, Z., Griffiths, M. D., . . . Demetrovics, Z. (2017). Problematic social media use: Results from a large-scale nationally representative adolescent sample. *PLoS ONE, 12,* e0169839. http://dx.doi.org/10.1371/journal.pone.0169839

Bornovalova, M. A., Daughters, S. B., Hernandez, G. D., Richards, J. B., & Lejuez, C. W. (2005). Differences in impulsivity and risk-taking propensity between primary users of crack cocaine and primary users of heroin in a residential substance-use program. *Experimental and Clinical Psychopharmacology, 13,* 311–318. http://dx.doi.org/10.1037/1064-1297.13.4.311

Canavan, S. V., Forselius, E. L., Bessette, A. J., & Morgan, P. T. (2014). Preliminary evidence for normalization of risk taking by modafinil in chronic cocaine users. *Addictive Behaviors, 39,* 1057–1061. http://dx.doi.org/10.1016/j.addbeh.2014.02.015

Crowley, T. J., Raymond, K. M., Mikulich-Gilbertson, S. K., Thompson, L. L., & Lejuez, C. W. (2006). A risk-taking "set" in a novel task among adolescents with serious conduct and substance problems. *Journal of the American Academy of Child & Adolescent Psychiatry, 45,* 175–183. http://dx.doi.org/10.1097/01.chi.0000188893.60551.31

Fernie, G., Cole, J. C., Goudie, A. J., & Field, M. (2010). Risk-taking but not response inhibition or delay discounting predict alcohol consumption in social drinkers. *Drug and Alcohol Dependence, 112,* 54–61. http://dx.doi.org/10.1016/j.drugalcdep.2010.05.011

Griffiths, M. D., Kuss, D. J., & Demetrovics, Z. (2014). Social networking addiction: An overview of preliminary findings. In K. P. Rosenberg & L. C. Feder (Eds.), *Behavioral addictions: Criteria, evidence, and treatment* (pp. 119–141). New York, NY: Elsevier. http://dx.doi.org/10.1016/B978-0-12-407724-9.00006-9

Hanson, K. L., Thayer, R. E., & Tapert, S. F. (2014). Adolescent marijuana users have elevated risk-taking on the Balloon Analog Risk Task. *Journal of Psychopharmacology, 28,* 1080–1087. http://dx.doi.org/10.1177/0269881114550352

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press. http://dx.doi.org/10.1111/jedm.12050

Izquierdo, A., & Jentsch, J. D. (2012). Reversal learning as a measure of impulsive and compulsive behavior in addictions. *Psychopharmacology, 219,* 607–620. http://dx.doi.org/10.1007/s00213-011-2579-7

Karaiskos, D., Tzavellas, E., Balta, G., & Paparrigopoulos, T. (2010). P02-232: Social network addiction: A new clinical disorder? *European Psychiatry, 25,* 855. http://dx.doi.org/10.1016/S0924-9338(10)70846-4

Koffarnus, M. N., & Kaplan, B. A. (2018). Clinical models of decision making in addiction. *Pharmacology Biochemistry and Behavior, 164,* 71–83. http://dx.doi.org/10.1016/j.pbb.2017.08.010

Lejuez, C. W., Aklin, W. M., Jones, H. A., Richards, J. B., Strong, D. R., Kahler, C. W., & Read, J. P. (2003). The Balloon Analogue Risk Task (BART) differentiates smokers and nonsmokers. *Experimental and Clinical Psychopharmacology, 11,* 26–33. http://dx.doi.org/10.1037/1064-1297.11.1.26

Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., . . . Brown, R. A. (2002). Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). *Journal of Experimental Psychology: Applied, 8,* 75–84. http://dx.doi.org/10.1037/1076-898X.8.2.75

Meshi, D., Elizarova, A., Bender, A., & Verdejo-Garcia, A. (2019). Excessive social media users demonstrate impaired decision making in the Iowa Gambling Task. *Journal of Behavioral Addictions, 8,* 169–173. http://dx.doi.org/10.1556/2006.7.2018.138

Meshi, D., Tamir, D. I., & Heekeren, H. R. (2015). The emerging neuroscience of social media. *Trends in Cognitive Sciences, 19,* 771–782. http://dx.doi.org/10.1016/j.tics.2015.09.004

Mueller, S. T. (2012). PEBL: The psychology experiment building language (Version 0.13). Retrieved from http://pebl.sourceforge.net/

Statista. (2019). Number of global social network users 2010–2021. Retrieved from https://www.statista.com/statistics/278414/number-of-worldwide-social-network-users/

Swainson, R., Rogers, R. D., Sahakian, B. J., Summers, B. A., Polkey, C. E., & Robbins, T. W. (2000). Probabilistic learning and reversal deficits in patients with Parkinson's disease or frontal or temporal lobe lesions: Possible adverse effects of dopaminergic medication. *Neuropsychologia, 38,* 596–612. http://dx.doi.org/10.1016/S0028-3932(99)00103-7

Verdejo-Garcia, A., Chong, T. T. J., Stout, J. C., Yücel, M., & London, E. D. (2018). Stages of dysfunctional decision-making in addiction. *Pharmacology Biochemistry and Behavior, 164,* 99–105. http://dx.doi.org/10.1016/j.pbb.2017.02.003


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