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## Evidence for an Internet Addiction Disorder:

### Internet Exposure Reinforces Color Preference in Withdrawn Problem Users

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#### ABSTRACT

**Objective:** This study examined whether exposure to the Internet could create a preference for colors associated with visited Web sites and explored the possible relationship with self-reported problematic Internet use and Internet deprivation.

**Method:** 100 adult participants were divided into 2 groups; one was deprived access to the Internet for 4 hours, and the other was not. After this period, they were asked to choose a color and complete a series of psychometric questionnaires concerning mood (Positive and Negative Affect Schedule), anxiety (Spielberger State-Trait Anxiety Inventory), and depression (Beck Depression Inventory). They were then given a 15-minute exposure to the Internet, and the Web sites they visited were recorded. They were then asked to again choose a color, complete the same psychometric questionnaires, and complete the Internet Addiction Test. The study was conducted between November 2013 and April 2014.

**Results:** For Internet-deprived, but not nondeprived, subjects, a reduction of mood and increased anxiety was noted in the higher problematic Internet users following Web cessation. There was also a shift toward choosing the color most prominent on the visited Web sites in these participants. No shift in mood, or toward choosing the dominant Web site color, was seen in the lower problem users.

**Conclusions:** These findings suggest that the Internet can serve as a negative reinforcer for behavior in higher problem users and that the reinforcement obtained from the alleviation of withdrawal symptoms becomes conditioned, with the color and appearance of the visited Web sites giving them a more positive value.

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Problematic use of the Internet has been suggested to be a growing problem in many parts of the world,<sup>1,2</sup> with between 2% and 20% of the population reporting some level of problematic Internet use.<sup>2–4</sup> Such problematic Internet use is manifest by individuals spending long periods each day on the Internet at the expense of other important activities,<sup>5,6</sup> resulting in disruptions to their social life,<sup>7,8</sup> work and education,<sup>9</sup> psychological state,<sup>10–12</sup> and physical functioning.<sup>13–15</sup> It has been suggested that such problematic use of the Internet might be regarded as an addiction akin to other behavioral addictions such as gambling<sup>3,16</sup> and that further investigation into this phenomenon is needed.<sup>16</sup>

A number of reports have explored the degree to which “Internet withdrawal” effects can be seen in those who report high levels of problematic Internet use when they cease using the Internet.<sup>12,17</sup> High problem Internet users experience negative mood swings on cessation of an Internet session,<sup>12</sup> and a prolonged absence from the Internet leads to increased levels of anxiety in these individuals,<sup>17</sup> suggesting that psychological Internet withdrawal effects may occur in high problem users. The current experiment explored the phenomenon of Internet addiction and withdrawal further by examining whether exposure to the Internet can establish preferences for aspects of the Web sites visited in those sessions, such as their color, as has been noted for many addictive substances.<sup>18–20</sup> If Internet addiction follows the same pattern as other addictions,<sup>18</sup> then when an individual suffering from an addiction is given access to the target of that addiction, aspects of the situation associated with the presence of that target become positively valued.

Experiments have established that rats will show a preference for the place associated with the administration of heroin or cocaine<sup>18</sup> and that humans will show a preference for a color associated with a caffeine drink.<sup>19,21</sup> However, these caffeine-conditioning effects are noted only if participants are in a state of caffeine withdrawal—that is, if they have been deprived access to caffeine for some time.<sup>19,20</sup> This suggests that caffeine dependence and withdrawal are potent factors in the establishment of reinforcement by caffeine in humans; the positive feelings associated with the alleviation of the withdrawal symptoms condition to aspects of the situation/stimulus that produced alleviation of the withdrawal symptoms.<sup>19,20</sup> The current experiment sought to use a procedure based on these caffeine-conditioning experiments to explore whether a period of Internet deprivation (withdrawal) would produce similar effects in terms of color preferences that might be established as a result of exposure to the Internet. Again, this would establish the similarity of the characteristics of problematic Internet and other addictions and investigate the strength of the concept of an Internet addiction.

To this end, following a period in which the participants were either denied access to or could access the Internet, they completed series of

- The nature of "Internet addiction disorder" is not well understood, and the current report attempted to assess whether those scoring high on a self-report measure of problematic Internet use displayed similar reactions to the object of their addiction to those with substance abuse problems.
- The results demonstrated that the cues associated with Internet exposure may gain hedonic status in withdrawn heavy Internet users in a similar way as they do for substance abusers.
- The findings suggest that individuals scoring highly on psychometric measures of problem Internet use should be considered similarly to those with other addiction problems.

psychometric tests in order to establish their mood, and they were also asked to choose a color. Following a subsequent session on the Internet, they were asked to choose a color and complete the psychological tests again, as well as complete the Internet Addiction Test. If individuals reporting high problem use of the Internet display behaviors indicative of a behavioral addiction, then it might be expected that they would show a negative mood swing and increased anxiety following exposure to the Internet.<sup>12,17</sup> It was also hypothesized that if Internet addiction were similar to other addictions, then individuals with high levels of self-reported Internet problems would show a shift in preference to the color most associated with the Web sites that they had visited during their exposure to the Internet. This would suggest that exposure to the Internet had produced a positive association with the characteristics of the Web sites visited. Again, if problematic Internet use is similar to a behavioral addiction, then any such effect should be most readily manifest in the Internet-deprived individuals.

## METHOD

### Participants

One hundred participants (61 females and 39 males) were recruited in a psychology department of a university in the United Kingdom. All participants were students and were volunteers—none received any form of compensation for their participation. The participants had a mean age of 22.47 years ( $\pm 2.98$ ; range, 18–30), and none reported any history of psychiatric problems or addictions. The study was granted ethics permission from the Department of Psychology Ethics Board, Swansea University.

### Typical Internet Use

Participants were asked about their average Internet use by asking them to estimate the number of hours per day that they had spent on the Internet over the last 2 months; this measure is commonly taken in studies of problematic Internet use.<sup>14,22</sup> The mean number of hours per day of Internet use reported was 5.73 ( $\pm 3.73$ , range, 0.33–16); 31% reported spending between 0 and 3 hours per day online, 36% reported spending between 3 to 6 hours per day online, and

33% reported spending more than 6 hours per day online. For females, this was 5.19 hours ( $\pm 3.45$ ; range, 0.33–16), and for males, this was 6.58 hours ( $\pm 3.93$ ; range, 0.5–16). An independent group *t* test revealed that this difference was not statistically significant ( $t_{98} = 1.83$ ,  $P > .08$ ,  $d = 0.38$ ).

The participants reported accessing the Internet a mean of 10.35 times per day ( $\pm 15.28$ ; range, 1–100); 56% reported accessing the Internet up to 5 times per day, 34% reported accessing the Internet between 6 and 10 times per day, and 20% reported accessing the Internet more than 10 times per day. The Internet was accessed by females a mean of 11.71 times per day ( $\pm 17.73$ ; range, 1–100) and by males, 10.41 times per day ( $\pm 9.83$ ; range, 1–50); this difference was not statistically significant ( $t_{98} = 0.42$ ,  $P > .60$ ,  $d = 0.10$ ).

## Materials

**Internet Addiction Test.** The Internet Addiction Test (IAT)<sup>23</sup> is a 20-item scale covering the degree to which Internet use disrupts everyday life. The overall score ranges from 20 to 100. The factor structure of the IAT is currently debated,<sup>22,24</sup> but a cutoff score of 40 or more for the total IAT score is taken as representing some level of problematic Internet usage.<sup>5,12,23</sup> The internal reliability of the scale has been found to be between 0.90<sup>5</sup> and 0.93<sup>2</sup> (calculated as 0.91 for the current sample). The scale also has good concurrent validity with other measures of disruptive Internet use.<sup>22</sup>

**Positive and Negative Affect Schedule.** The Positive and Negative Affect Schedule (PANAS)<sup>25</sup> is a 20-item questionnaire designed to measure participants' positive and negative moods. The total scores can range from 10 to 50. The internal reliability of both the positive and negative scales is 0.90<sup>25</sup> (calculated as 0.84 for the current sample). The scale also correlates well with other measures of mood such as the Hospital Anxiety and Depression Scales.<sup>26</sup>

**Spielberger State-Trait Anxiety Inventory.** The Spielberger State-Trait Anxiety Inventory (STAI)<sup>27</sup> rates the affective, cognitive, and physiological manifestations of anxiety in terms of long-standing patterns (trait anxiety) and current anxiety (state), but only the latter was used for this study. The total score for each scale ranges from 20 to 80. The internal reliability of the scale is 0.93<sup>27</sup> (calculated as 0.82 for the current sample). There is strong evidence regarding its validity.<sup>27</sup>

**Beck Depression Inventory.** The Beck Depression Inventory (BDI)<sup>28</sup> is a 21-item questionnaire that assesses the clinical symptoms of depression through asking about feelings over the past week. The score ranges from 0 to 63. The internal reliability of the scale is 0.93<sup>28</sup> (calculated as 0.90 for the current sample). Reviews have noted that the scale has excellent validity.<sup>29</sup>

## Procedure

The participants initially experienced a 4-hour teaching session, unrelated to issues concerned with the Internet, which took place in the University. Half of the participants ( $n = 50$ ) were explicitly told to switch off their mobile devices and to leave them at the door of the teaching room in which

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the session occurred. The Internet connection was disabled on the PCs in the room. The other participants experienced the same teaching session but were allowed to keep their mobile phones with them, and the PCs were not Internet disabled (they were not explicitly told that they could access their mobile phones, etc). The 4-hour length of the period was chosen for a number of reasons: it is similar to lengths of time that have been chosen for studies of substance abuse,<sup>20</sup> but it also corresponded to the longest period of teaching that was already scheduled in the timetable (which was organizationally fortuitous and would not make the session seem out of the ordinary for the students).

All subsequent testing was completed individually in small experimental cubicles. Participants were told that this was an assessment of personality and color preferences. The participants were then asked to name the first color that came into their mind (which was recorded by the experimenter) and were asked to complete the BDI, STAI, and PANAS questionnaires.

After completing the psychometric tests, the participants were told that the questionnaires had to be scored and that the experimenter would return in a short time to complete the experiment. The participants were asked to wait in the experimental room and were told that they could access the Internet through the computer in the room. All participants accessed the Internet, and the content of the Web sites they visited was recorded. A short 15-minute Internet period was used in this study, as this has been found previously to be long enough to produce psychological changes in high problem users.<sup>12</sup> Moreover, shorter periods of Internet use are more reflective of current methods of interacting with the Internet since the advent of mobile devices.<sup>17</sup>

After a 15-minute period of Internet exposure, the experimenter returned to the room, and the participants were asked to switch off the Internet and were told that the next part of the study comprised a further series of questionnaires. They were again asked to name the first color that came into their mind and were asked to complete the PANAS and STAI questionnaires again (in that order), as well as the IAT questionnaire, which was always completed last.

After the participants had left the room, the record of their Internet activity was recovered from the Internet browser history (the participants had not been informed that their browsing activities would be checked). The number of Web sites that were visited during the 15-minute period was recorded, along with their address. It was possible to recover these records for 83 participants—17 had deleted this record from the computer. The dominant color of the Web sites visited by each participant was assessed by 2 independent raters who were blind to the results of the psychometric tests from the participants. Each rater separately visited each of the Web sites recorded on the browser history for each participant. The raters noted the main colors displayed on those Web site pages (ie, those colors that occupied more than 25% of the Web page, so that it was theoretically possibly to have more than 1 prominent color per Web site). The

dominant colors on each Web page were assessed by visual inspection. This was done for each Web page separately. The color most often noted across all the Web pages visited by the individual was then calculated. There was a 97% agreement between the raters regarding the dominant colors. Disagreements were settled by negotiation.

The study was conducted between November 2013 and April 2014.

## RESULTS

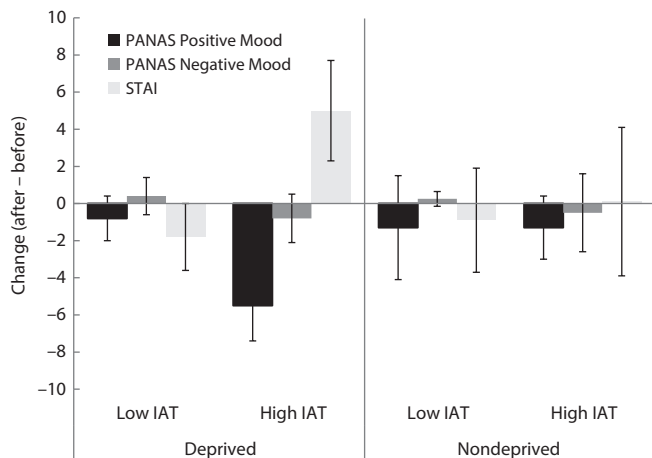
The mean ( $\pm$  SD) number of Web sites visited by the participants during the 15-minute period was 2.66 ( $\pm$  1.75; range, 1–8). The Internet-deprived group visited 2.91 ( $\pm$  2.06; range, 1–8) Web sites during their Internet exposure, and the nondeprived group visited 2.43 ( $\pm$  1.36; range, 1–8) Web sites ( $t_{98} = 1.25$ ,  $P > .20$ ,  $d = 0.29$ ).

The mean IAT score for the sample was 35.57 ( $\pm$  11.72; range, 11–72), and 27 participants scored higher than the IAT cutoff (ie, 40) for mild or worse problematic Internet use. The mean IAT score for females was 35.69 ( $\pm$  12.35; range, 11–72; 26.2% scored above the cutoff), and the mean IAT score for males was 35.38 ( $\pm$  10.82; range, 11–72; 28.2% scored above the cutoff). The difference between the genders in terms of their IAT scores was not statistically significant ( $t_{98} = 0.12$ ,  $P > .90$ ,  $d = 0.03$ ). The mean IAT score for the Internet-deprived group was 35.50 ( $\pm$  12.17; range, 11–72; 24% scored above the cutoff), and for the nondeprived group, the mean was 35.64 ( $\pm$  11.38; range, 11–72; 30% scored above the cutoff). The difference between these groups was not statistically significant ( $t_{98} = 0.06$ ,  $P > .90$ ,  $d = 0.01$ ). The IAT score had significant correlations with depression (BDI;  $r_{98} = 0.208$ ,  $P < .05$ ), anxiety (STAI;  $r_{98} = 0.252$ ,  $P < .01$ ), hours spent on the Internet ( $r_{98} = 0.257$ ,  $P < .05$ ), and number of visits to the Internet per day ( $r_{98} = 0.388$ ,  $P < .001$ ).

The cohort was split into lower problem users (ie, those scoring below the IAT cut off of 40) and a higher problem user group (ie, those scoring 40 or above on the IAT). This split according to IAT score combined with the deprivation group allocation to create 4 groups: low problem users with no deprivation ( $n = 35$ ; mean  $\pm$  SD IAT = 30.06  $\pm$  7.78; range, 11–39); low problem users with deprivation ( $n = 38$ ; mean IAT = 30.08  $\pm$  4.93; range, 20–39); high problem users with no deprivation ( $n = 15$ ; mean IAT = 48.67  $\pm$  6.82; range, 40–61); and high problem users with deprivation ( $n = 12$ ; mean IAT = 52.67  $\pm$  12.44; range, 40–72).

Figure 1 shows the change in the psychological ratings (the score after the Internet minus the score before the Internet session) for the high and low problematic Internet user groups who had and had not been deprived of Internet access. Inspection of these data shows that, for the Internet-deprived groups, higher problem users demonstrated a decreased positive mood and increased levels of anxiety following Internet exposure compared to lower problem users. However, there was no effect in the Internet-nondeprived groups. Separate 2-factor between-subject analyses of variance with IAT group (lower versus

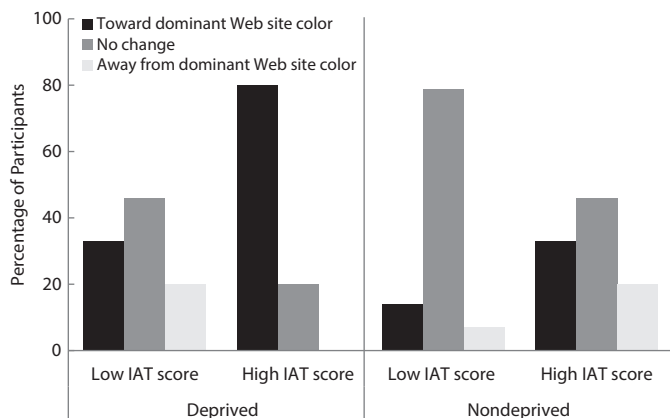
**Figure 1. Change in Levels of Positive Mood (PANAS Positive), Negative Mood (PANAS Negative), and Anxiety (STAI) After Relative to Before an Internet Session for Lower and Higher Problem Users Who Were Either Deprived or Not Deprived of Internet Access<sup>a</sup>**



<sup>a</sup>Error bars = 95% confidence intervals.

Abbreviations: PANAS = Positive and Negative Affect Schedule, STAI = Spielberger State-Trait Anxiety Inventory.

**Figure 2. Change in the Selection of Colors After Relative to Before an Internet Session for Lower and Higher Problem Users Who Were Either Deprived or Not Deprived of Internet Access**



Abbreviation: IAT = Internet Addiction Test.

higher) and deprivation group (deprived versus nondeprived) were conducted on each of the 3 psychological measures. For the change in positive mood, there was a significant main effect of IAT ( $F_{1,96} = 3.63$ ,  $P < .05$ , partial  $\eta^2 = 0.036$ ), but not of deprivation ( $F_{1,96} = 2.10$ ,  $P > .10$ , partial  $\eta^2 = 0.021$ ), and there was a significant interaction between the factors ( $F_{1,96} = 3.69$ ,  $P < .05$ , partial  $\eta^2 = 0.037$ ). Simple effect analyses conducted for each deprivation group revealed a significant simple effect of IAT group for the Internet-deprived condition ( $F_{1,96} = 6.84$ ,  $P < .01$ , partial  $\eta^2 = 0.067$ ), but not for the nondeprived condition ( $F < 1$ , partial  $\eta^2 = 0.001$ ). For the change in negative mood, there were no significant main effects or interactions (all  $P$  values  $> .20$ , all partial  $\eta^2$  values  $< 0.01$ ). For the change in anxiety, there was a

significant main effect of IAT ( $F_{1,96} = 6.06$ ,  $P < .05$ , partial  $\eta^2 = 0.064$ ), but not of deprivation ( $F_{1,96} = 1.89$ ,  $P > .10$ , partial  $\eta^2 = 0.021$ ), and there was a significant interaction between the factors ( $F_{1,96} = 3.84$ ,  $P < .05$ , partial  $\eta^2 = 0.038$ ). Simple effect analyses conducted for each deprivation condition revealed a significant simple effect of IAT group for the deprived condition ( $F_{1,96} = 9.59$ ,  $P < .01$ , partial  $\eta^2 = 0.091$ ), but not for the nondeprived condition ( $F < 1$ , partial  $\eta^2 = 0.002$ ).

Figure 2 shows the change in color selection as a result of the Internet session for the higher and lower problem user groups who had and had not been deprived of Internet access. A change to the predominant color of the Web sites (ie, this color was selected after but not before Internet exposure) was scored as a change toward the dominant Web page color experienced by that participant; no change in selection, or a random change unrelated to the Web site colors, was scored as no change; and a change away from the predominant Web site color (ie, this color was selected before but not after Internet exposure) was scored as a change away. Inspection of these data reveals that, for the Internet-deprived groups, there was a marked change toward the predominant Web page color for the higher problem users, but not for the lower problem users. There was little difference in color change noted between the higher and lower problem user groups for the Internet-nondeprived groups, with their color shifts tending to be random relative to the Web site colors.

These data were analyzed using a  $\chi^2$  for 3 categorical variables (change in color preference, lower versus higher problem user groups, and Internet deprivation). This analysis showed that, while there was an overall significant effect of IAT level on the change in color choice ( $\chi^2_2 = 6.40$ ,  $P < .05$ ), the partial  $\chi^2$  was significant only for the participants who had been Internet deprived ( $\chi^2_2 = 6.93$ ,  $P < .01$ ) and not for the participants who had not been Internet deprived ( $\chi^2_2 = 4.56$ ,  $P > .10$ ).

## DISCUSSION

The current results demonstrated that a color preference could be conditioned by exposure to the Internet in higher but not lower problem users and that this effect was seen only when there was some degree of Internet deprivation prior to the test. This effect is further evidence about the nature of problematic Internet use as a potential addiction<sup>16</sup> and also gives insight into the potential impact of Internet exposure on preference development in some individuals.

This finding regarding deprivation on the Internet-conditioning effect is consistent with the caffeine-conditioning literature.<sup>19,20</sup> It suggests that the mechanism of action for this Internet-conditioning effect is the alleviation of negative symptoms of

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withdrawal generating a positive valence for the stimuli associated with that alleviation.<sup>20,30</sup> The differences found between the lower and higher problem Internet user groups are likely to be due to withdrawal symptoms from the Internet among the higher problem user group, which are alleviated by reexposure to the Internet.<sup>12,17</sup> The participants are conditioned to associate the alleviating effects of Internet exposure with the stimuli associated with the visited Web pages, resulting in an increase in positive valence for those stimuli.<sup>19,30</sup> That this effect was not seen in the lower problem users, for whom the Internet exposure did not increase the valence of stimuli associated with the Web pages, suggests that in the absence of withdrawal effects in lower problem users there is no negative reinforcing effect of the Internet per se, providing further evidence that Internet can act as a negative reinforcer.

The current study replicated the psychological withdrawal effect on cessation of using the Internet.<sup>12,17</sup> However, a novel aspect of the current data was that this psychological withdrawal effect was limited to those with high levels of self-reported problematic Internet use who had been deprived from the Internet for at least 4 hours, which is similar to previous studies of the effects of substance abuse.<sup>20</sup> That only those who were Internet deprived showed this effect, and that only those who were Internet deprived showed the Internet-conditioning effect, suggests that alleviating this withdrawal state may well be critical in maintaining Internet use in some problematic Internet users, as it is in some caffeine users.<sup>19,30</sup>

The demonstration that color choice can be conditioned from Internet exposure, at least in the short term, might allow the use of further conditioning techniques to revalue the status of the Internet and alter the behavior of high problem users. It has been shown in many contexts that altering the hedonic status of a stimulus (eg, a color) associated with a second stimulus (eg, the Internet) can, without further conditioning, alter the status of that second stimulus (the

Internet).<sup>31</sup> The use of this procedure could act to reduce subsequent Internet use and help maintain longer periods of abstinence in problematic users. Of course, the potential use of this suggested procedure is speculative, and further work would be required to explore its potential.

It is worth noting that around a third of the current sample displayed a mild or worse form of Internet addiction. This value is similar to those found in previous studies from the same areas in the world.<sup>2-4,15</sup> The fact that this problem appeared to be distributed similarly among males and females is also in line with contemporary reports that have shown a narrowing in the gender gap in terms of problematic Internet use.<sup>9</sup> Levels of Internet addiction were also correlated with levels of depression and anxiety, as has been noted in several previous investigations.<sup>5,8</sup>

As with any study, there are some methodological limitations that should be acknowledged. The current study, although attempting to be ecologically valid, may not capture all of the aspects of everyday Internet use that might contribute to these effects. It is unknown how long the current preference conditioning lasts, which could be further examined in subsequent work. The level of deprivation was chosen on the basis of previous work, but this level might have an effect on the results and should be explored in some more detail. More precise methods of establishing dominant colors on the screen could be examined in future work.

In summary, the current data show that problematic Internet users who have been deprived access to the Internet for some hours will display psychological withdrawal effects after finishing an Internet cessation. This exposure is enough to generate an Internet-conditioning effect for stimuli associated with the visited Web pages, making stimuli associated with the Web pages more valued, which is an effect seen with some addictive substances. These findings add to the evidence that the concept of Internet addiction should be given serious consideration.

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