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Research Article

Exploring the Cold-to-Hot Empathy Gap in Smokers

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ABSTRACT—Many decisions related to cigarette smoking require people in an affectively neutral, or “cold,” state to predict how they will feel or behave when in a craving, or “hot,” state. Research in other domains has revealed that individuals in cold states often underestimate the impact of being in a hot state on their own future behavior. In a study testing whether this is true of cigarette craving, 98 smokers were assigned to one of three conditions: hot (during a high-craving first session, they made predictions about a high-craving state in a second session), cold (during a low-craving first session, they made predictions about a high-craving state in a second session), and comparison (they experienced a high-craving session only). As predicted, in contrast to smokers in the hot group, smokers in the cold group underpredicted the value they would place on smoking during the second session. Results support the existence of a cold-to-hot empathy gap in smokers and help to explain diverse aspects of tobacco addiction.

Although craving has long been hypothesized to play a role in addiction (Niaura et al., 1988; World Health Organization, 1955), only recently has research provided support for this belief. Observational studies have found that craving ratings predict drug relapse in both adults (e.g., Killen & Fortmann, 1997; Shiffman et al., 1997) and adolescents (e.g., Bagot, Heishman, & Moolchan, 2007). Other studies have disentangled the cognitive and motivational dimensions of craving (see Baker, Morse, & Sherman, 1987; Sayette, 2004) and identified effects ranging from impacts on basic perception to consequences for higher-order decision making. For example, studies using diverse methods, such as dot-probe tasks, emotional Stroop tasks, and eye tracking, have found that drug craving draws upon attentional resources and focuses attention on drug-related cues and away from stimuli unrelated to drug use (e.g., Cepeda-Benito &

Tiffany, 1996; Cox, Fadardi, & Pothos, 2006; Sayette & Hufford, 1994; Waters & Sayette, 2006), and, more specifically, one study has found that such attentional bias actually predicts smoking relapse (Waters et al., 2003).

In addition to changes in attentional processes, a variety of cognitive and decision-making shifts that may promote smoking have been observed (Sayette, Martin, Hull, Wertz, & Perrott, 2003). For example, compared with when they are not craving, smokers who are craving tend to generate more positive, but not more negative, aspects of smoking (Sayette & Hufford, 1997), and also to evaluate positive, but not negative, consequences of smoking to be more likely to occur (e.g., Sayette, Loewenstein, Kirchner, & Travis, 2005). According to this motivated-cognition view of craving, the decision to smoke is thought to become more attractive during high craving states (see Sayette, 2004). Craving smokers also tend to anticipate that their craving will intensify over time if they do not smoke, although in actuality this often is not the case (Sayette et al., 2005, Experiment 2). Finally, studies have found that craving smokers experience a slowing down of time (Klein, Corwin, & Stine, 2003; Sayette et al., 2005), which is consistent with Vohs and Schmeichel's (2003) depiction of an “extended now” state. Both the anticipated intensification of craving and the feeling that time is moving slowly may contribute to a sense of desperation among smokers trying to resist an urge to smoke.

Drug addiction is not the only motivational state that produces such wide-ranging effects. According to a “visceral model of addiction” proposed by Loewenstein (1999), drug addiction is only one, albeit an extreme, example of a wide range of behaviors that are influenced or controlled by “visceral factors,” which include, in addition to drug craving, motivational states (e.g., hunger, thirst, and sexual desire), moods and emotions, and physical pain.

One key premise of the visceral account of addiction is that people underestimate the extent to which visceral factors they will experience in the future will affect their own behavior. This is referred to as the *cold-to-hot empathy gap*—the tendency for individuals when “cold” (i.e., when not experiencing an elevated visceral factor) to miscalculate how they will behave when

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“hot” (i.e., when experiencing an elevated visceral factor; Loewenstein, 1996), in part because they cannot recall the intensity of their own past cravings.

In a series of studies dealing with a range of positive and negative visceral states, Loewenstein and other researchers have documented the occurrence of cold-to-hot empathy gaps for visceral states as diverse as sexual arousal, hunger, pain, and embarrassment (see Loewenstein, 2004). Moreover, a preliminary study involving 13 heroin users provided support for the cold-to-hot empathy gap with respect to drug craving (Badger, Bickel, Giordano, Jacobs, & Loewenstein, 2007). The study found that addicts placed greater monetary value on receiving an extra dose of opiate 5 days later if they made the decision right before receiving their current opiate treatment (when they were likely to be in a high-craving state) than if they made the same decision minutes later, after they had received their current treatment and were in a low-craving state.

Other research has examined the consequences of cold-to-hot empathy gaps for a wide range of behaviors and attitudes. In one set of studies, participants evaluated a person who succumbed to a visceral drive more negatively when they were not themselves experiencing the same drive (Nordgren, van der Pligt, & van Harreveld, 2007) than when they were experiencing that drive. For example, people evaluated an individual who stuffed himself with hamburgers much more unfavorably when they themselves were not hungry than when they were hungry. In another set of studies, people were less merciful in evaluating their own past viscerally motivated behavior when they were not currently experiencing the same visceral state (Nordgren, van der Pligt, & van Harreveld, 2006). And in the study most closely related to the current study (Nordgren, van der Pligt, & van Harreveld, in press), smokers who were induced to experience cigarette craving were less optimistic about their own ability to quit than were satiated smokers and, as a result, expressed lower intentions to quit smoking in the future.

In the study reported here, we examined the cold-to-hot empathy gap in a group of active smokers, and specifically examined whether the monetary value that smokers place on future smoking depends on their current state of craving. If smokers who are not craving have trouble imagining what it is like to crave, as predicted by the cold-to-hot empathy gap, then they should place a lower value on future smoking than those who are actively craving.

Participants in the two key conditions attended two sessions. In the initial session, they were either craving or not craving, and were asked to predict how much money they would need to postpone smoking during a future session, when they would be craving. During the second session, they were given a chance to revise their valuations. The rewards received for actually postponing smoking were both real (i.e., additional money) and immediate. This type of measure has several advantages over more traditional choice measures that have involved hypothetical outcomes (e.g., Perkins, Grobe, & Fonte, 1997). A behav-

ioral choice measure with real consequences also addresses concerns about the sensitivity of self-report ratings of motivation. Ratings of the urge to smoke are often subject to ceiling effects because it is common for nicotine-deprived smokers to provide maximal or near-maximal ratings (see Sayette et al., 2000). Were high urge ratings to be recorded during the initial session, it would be virtually impossible for them to underpredict urges during the second session. (For a detailed discussion of the advantages of a nonhypothetical behavioral choice measure over self-report ratings of visceral states, see Read & Loewenstein, 1999).

In sum, we hypothesized that smokers would exhibit a cold-to-hot empathy gap. Specifically, we hypothesized that participants in a noncraving state (in Session 1) would assign lower values to being able to smoke at a future point when they would be craving (in Session 2) than they would assign at that future time (i.e., they would underpredict their future craving); in contrast, we hypothesized that this underprediction would not be observed among participants who made the initial prediction while in a craving state.

METHOD

Participants

Male and female smokers ($N = 98$) were recruited through newspaper advertisements and local fliers inviting inquiries from smokers willing to refrain from smoking for up to 2 days. Participants were required to be between the ages of 18 and 40, to have smoked at least 10 cigarettes per day for the past 12 months, and to not be currently interested in quitting. Participants were randomly assigned to three conditions. The two key conditions (*hot* and *cold*) were designed to differ in the smokers' affective state during Session 1. In addition, we included a *comparison* condition in which participants did not make predictions (i.e., they attended the second session only). The three experimental groups did not differ in age ($M = 27.1$ years, $SD = 6.4$), ethnicity (61% Caucasian, 36% African American, 3% other), gender (47% female, 53% male), marital status (70% single, 23% living with a partner, 7% married), number of cigarettes per day ($M = 17.2$, $SD = 6.9$), or nicotine dependence, as assessed using the Fagerström Test for Nicotine Dependence ($M = 4.9$, $SD = 1.9$; Heatherton, Kozlowski, Frecker, & Fagerström, 1991).

Measures

Participants completed a questionnaire battery that included a demographic form and a standard form for assessing smoking history, smoking patterns, and current interest in quitting (see Sayette, Martin, Wertz, Shiffman, & Perrott, 2001). In addition, they completed measures of their willingness to accept craving (WTAC) and urge to smoke.

WTAC

Our WTAC measure was based on a monetary choice task used in our prior smoking research (Sayette et al., 2001) and the willingness-to-accept-pain task described by Read and Loewenstein (1999). Participants chose between immediate access to a cigarette and delayed access with financial compensation. They indicated the minimum amount of money they would accept in order to postpone smoking for 5 min. They were told that if this value were less than a previously set but undisclosed amount, they would receive the amount they requested in return for delaying smoking. This monetary reward was included to enhance participants' belief that their responses would have real consequences and to encourage participants to report the smallest acceptable amount of money they required to delay smoking. The critical variable was the minimum amount of money they required to postpone smoking for 5 min.

Urge to Smoke

Self-reported urge to smoke was assessed using a rating scale ranging from 0 (*absolutely no urge to smoke at all*) to 100 (*strongest urge to smoke I've ever experienced*). This single-item scale has proven sensitive to a wide range of craving experiences (see Juliano & Brandon, 1998; Sayette et al., 2001). Participants rated their current urge to smoke in both sessions; in addition, in Session 1, they rated their anticipated urge in Session 2.

Experimental Design

As noted, the two key conditions in this study (hot and cold) differed in the smokers' affective state during Session 1. The comparison group did not participate in that session and only provided urge-to-smoke ratings and WTAC evaluations in Session 2, in a high-craving state. We included this additional group in case the WTAC evaluations participants in the hot and cold conditions provided in Session 1 exhibited anchoring effects (see Loewenstein & Adler, 1995). Such anchoring would attenuate the predicted underestimation in the within-subjects comparisons between sessions. If such anchoring occurred, it would result in the comparison groups' values being higher than the Session 2 values for the hot and cold groups. As outlined by Loewenstein and Adler, if anchoring is not found, then key analyses can contrast only the hot and cold conditions and focus on differences between predicted values in Session 1 and actual values in Session 2.

To satisfy power requirements, we assigned participants disproportionately to the hot and cold conditions (they were one third less likely to be assigned to the comparison condition). Participants in the hot group abstained from smoking for at least 12 hr prior to the first session and were exposed to smoking cues during the first session while they made predictions about the value of smoking during a subsequent session. Participants in the cold group smoked as they normally would before the first session and were exposed to a control cue unrelated to smoking

while they made their predictions during the first session. We have used this approach previously to create high- and low-craving conditions characterized by vastly different urge ratings (Sayette & Hufford, 1994; Sayette et al., 2005). (Note that this study did not aim to disentangle the separate effects of nicotine deprivation and cigarette-cue exposure. Instead, we sought to evaluate the impact of a robust craving state or a neutral state on the ability to predict a future craving state.) Comparison smokers, who did not participate in the first session, abstained from smoking for 12 hr before being exposed to smoking cues in the second session.

Procedure

After attending a screening session (modeled after that in Sayette et al., 2001) and providing a baseline carbon monoxide (CO) sample, eligible participants were randomly assigned to one of the three conditions. At that time, they were told to bring a pack of their preferred brand of cigarettes to the upcoming session. They were informed that they would be paid \$100 for participating in up to two sessions 7 days apart. They were also told that they might be required to abstain from smoking for 12 hr prior to these sessions and that breath samples would be obtained to ensure that they had conformed to the instructions.

Participants arrived for the experimental sessions between 3:00 p.m. and 5:00 p.m. After obtaining informed consent (only during the first session), we checked compliance with the deprivation instructions by asking subjects to report the last time they smoked a cigarette and measuring their CO levels. To reduce the chance of partial deprivation, we required that non-deprived smokers (i.e., smokers in the cold group, at Session 1) have a CO level above 10 ppm to participate; CO levels for nicotine-deprived smokers had to be either (a) lower than 20 ppm and at least 50% lower than the smokers' baseline CO levels (i.e., in a nondeprived state) or (b) below 10 ppm. Participants presented their cigarettes to the experimenter, who returned them after the session. They then completed a pre-cue-exposure urge rating.

Session 1

Session 1 began with practice in the WTAC task, so that we could be sure participants understood it. The task was explained, and a practice trial was administered. This practice was similar to the real trial except that participants were asked to imagine that they would have to endure pain (i.e., holding their hand in cold water), rather than smoking craving. We chose this example because we wanted participants to imagine feeling uncomfortable from a stimulus unrelated to the urge to smoke. Only after participants completed the practice trial and correctly answered three follow-up questions about the WTAC task did the study continue. (Six participants were unable to understand the pain example and were therefore not administered the WTAC task.)

The next step was the cue exposure. Participants in the cold condition, who had smoked normally on the day of the session, were exposed to the control cue. A tray containing a plastic cover was placed on the desk in front of these participants, and they were told not to touch the tray. After 20 s, they were instructed, via intercom, to pick up the cover on the tray. Participants found a roll of tape under the cover. They were asked to hold the tape in their dominant hand and to look at it. After 30 s, they rated their urge to smoke and then placed the tape back on the tray.

Participants in the hot condition, who were nicotine deprived for 12 hr, were exposed to the smoking cue. As in the cold condition, a tray with a plastic cover was placed on the desk in front of them, and they were told not to touch the tray. After 20 s, they were instructed to pick up the cover, thereby revealing the pack of cigarettes they had brought, a lighter, and an ashtray. They were told to remove a cigarette from the box and to light it without putting it in their mouth by holding it in the flame for several seconds until the tobacco began to burn. Next, they were told to put down the lighter, hold the cigarette in a comfortable manner, and look at it. Thirty seconds after lighting the cigarette, they rated their urge to smoke.

Next, participants in both conditions held the cue (cigarette or tape) while completing the WTAC task, which was administered in interview form over the intercom. They were asked to indicate the minimum amount of money they would need to delay smoking in Session 2, when they would be craving. Participants were told that they would receive the amount they requested for smoking delay if their value was less than a previously set amount that would be announced to them at Session 2, and that they would be expected to delay smoking if their answers in Session 1 indicated they would be willing to delay smoking for less than that amount. They were reminded that they would be required to abstain from smoking for 12 hr before Session 2 and that breath samples would be taken to verify that they had done so. The experimenter explained that during Session 2, they would be asked to light one of their own cigarettes by holding the tip of the cigarette in the flame without placing the cigarette in their mouth. They then were asked whether or not they thought they would want to smoke during Session 2. Participants who indicated that they would want to smoke were asked whether they expected that they would be willing to postpone smoking for 5 min for an additional \$25. All but 2 participants said they would, and these 2 were assigned this maximum value of \$25. The experimenter then asked participants if they expected that they would be willing to postpone smoking for 5 min for an additional 25¢, and nearly all participants indicated that they thought they would prefer to smoke immediately rather than accept this low amount. (Those few who said they would accept this amount were scored as having a cutoff point of 25¢.) A value midway between the unacceptable sum (25¢) and the acceptable sum (\$25 to start) then was offered, and this process was repeated until the exact crossover point (Griffiths, Rush, & Puhala, 1996) was reached. This point presumably reflected the

minimum monetary value of delaying smoking. Participants were told that the undisclosed money amount, which would determine whether they would have to delay smoking in Session 2, would be revealed to them at the beginning of that session.

Immediately following the WTAC task, participants in the hot and cold conditions were asked to rate their anticipated urge to smoke during the next session. Those in the hot group completed this rating while still holding the lit cigarette, and those in the cold group held the tape. For the latter participants, the protocol for the cigarette-cue exposure was explained in detail because they did not experience nicotine deprivation and had not lit or held one of their own cigarettes during Session 1.

Session 2

At the start of Session 2, participants in the hot and cold groups were informed that the undisclosed money amount would be revealed to them “shortly.” They were led through a smoking-cue exposure protocol identical to the one in Session 1 and rated their urge to smoke before and after lighting their cigarette. Once the cigarette was lit, participants performed the WTAC task, which provided the opportunity for them to revise their money amount from the WTAC task in Session 1. They were told there was a 50% chance that the revised, rather than the original, amount would be compared with the undisclosed money amount to determine whether they would be required to delay smoking for 5 min, as we did not want participants to perceive their choice during the prior session to have been meaningless (see Read & Loewenstein, 1999). The experimenter then led them through a WTAC task identical to that in Session 1, except that they were asked to indicate the minimum amount of money they would need to delay smoking for 5 min “right now.”

Participants in the comparison group attended only the second experimental session. They were nicotine deprived for 12 hr and were led through the smoking-cue exposure protocol (as in the hot and cold conditions), rating their urge to smoke before and after the cue exposure. These participants completed the WTAC only once (i.e., they were asked to indicate the minimum amount of money they would need to delay smoking for 5 min “right now”).

After the WTAC task, all participants were informed that they could smoke immediately and would receive an additional \$5, without having to delay smoking. They then completed a post-experimental form asking them about the study’s purpose, were debriefed, and were paid.

RESULTS

Figure 1 summarizes the WTAC ratings. An initial analysis tested anchoring effects by comparing the three groups’ WTAC values during smoking-cue exposure in Session 2. These values were similar across the three conditions, $F(2, 95) = 0.43, p = .65$. Thus, participants in the hot and cold groups, who were revising their original WTAC values, did not report lower values

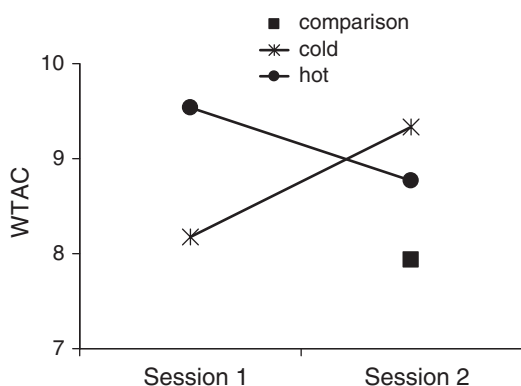


Fig. 1. Willingness to accept craving (WTAC), in dollars, as a function of condition and session.

(due to anchoring) than comparison participants. Accordingly, we focused our analyses on the hot and cold conditions.

Examination of the urge to smoke after cue exposure at the outset of the first WTAC task showed that participants in the hot group were experiencing significantly stronger urges ($M = 75.9$, $SD = 26.7$) than were participants in the cold group ($M = 26.7$, $SD = 27.4$), $F(1, 73) = 61.03$, $p < .0001$. These data indicate that participants in our hot and cold groups were experiencing the levels of craving necessary for us to test our hypothesis about the cold-to-hot empathy gap.

We conducted a 2 (group: hot or cold) \times 2 (session: 1 or 2) repeated measures analysis of variance with session as the repeated variable and the WTAC crossover point as the dependent variable. Of most relevance to the study was the significant group-by-session interaction, $F(1, 72) = 7.83$, $p < .007$. We next conducted a pair of simple-effects tests to examine the components of this significant interaction. Participants in the cold group showed a significant increase in the WTAC crossover point from Session 1 ($M = \$8.18$, $SD = 5.27$) to Session 2 ($M = \$9.33$, $SD = 5.34$), $p < .05$; this indicates that in the first session, they underpredicted the value of cigarette access in the following session. No such effect was found for participants in the hot group (Session 1 WTAC: $M = \$9.53$, $SD = 6.99$; Session 2 WTAC: $M = \$8.77$, $SD = 6.05$); indeed, there was a trend in the opposite direction. Figure 2 illustrates the dramatic difference in WTAC revisions between the two conditions. In the hot condition, the revisions centered around the no-change point, but in the cold condition, they were much more likely to be positive than negative.

A similar analysis examined anticipated urge to smoke during Session 1 and actual urge recorded after cue exposure during Session 2. As expected, ratings were very high; nearly half (46%) the participants gave their anticipated urge a rating of 90 or higher, which substantially limited the utility of this measure to assess underprediction. A 2 (group: hot or cold) \times 2 (urge: anticipated urge reported during Session 1 or current urge reported during Session 2) repeated measures analysis of variance did not reveal a significant interaction; however, findings were consistent

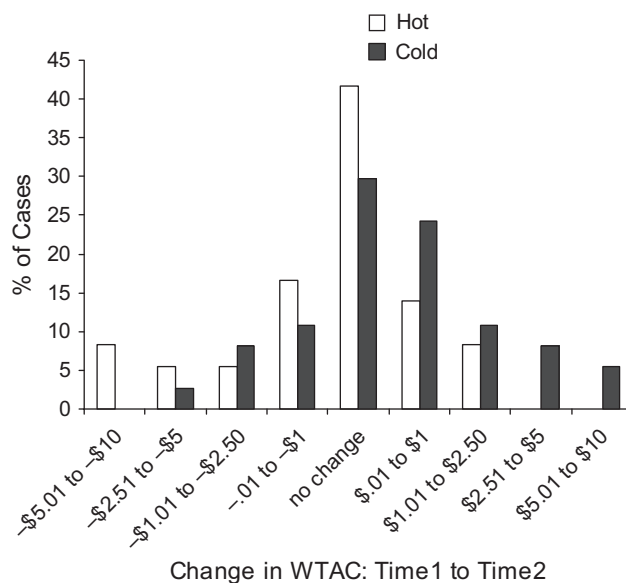


Fig. 2. Change in willingness to accept craving (WTAC) between Session 1 and Session 2. The graph shows the distribution of participants according to the change in their WTAC values (Session 2 WTAC – Session 1 WTAC), as a function of condition.

with those of the WTAC analysis in that the urge ratings of the cold group were in the direction of an underprediction.

DISCUSSION

This study provides support for the cold-to-hot empathy gap among smokers. In contrast to smokers in a hot (craving) state, those in a cold (noncraving) state underpredicted the value of smoking during a future session when they would be craving.

The underprediction of future cigarette craving has diverse implications. There has been considerable debate over whether smokers and nonsmokers over- or underestimate the risks of smoking, and different researchers have come to dramatically different conclusions (e.g., Slovic, 2001; Viscusi, 1992). Regardless of which perspective is correct, there may be a different type of misestimation that has more significant consequences. Failing to anticipate the motivational strength of cigarette craving, nonsmokers may not appreciate how easy it is to become addicted and how difficult it is to quit once addicted. If even individuals who are addicted to cigarettes cannot appreciate their own craving when they are not in a craving state, as this study suggests, how likely is it that, for example, a teenager who has never experienced cigarette craving can imagine what it is like to crave a cigarette? Indeed, there is considerable research that youths tend to underestimate their risk of becoming addicted to cigarettes. For example, the University of Michigan's Monitoring the Future longitudinal study (Johnston, O'Malley, & Bachman, 1993) found that although only 15% of respondents who were occasional smokers (less than one cigarette per day) predicted that they might be smoking in 5 years, 43% of them

were, in fact, smoking 5 years later (see Slovic, 2001, for a review of the evidence on this point).

The underprediction of cigarette craving may also help to explain the frequency with which smokers attempt to quit, despite dismal rates of success. Initial efficacy judgments often are made in a neutral state in the clinic, rather than the high states of craving that have to be endured to remain abstinent (for more discussion of hot and cold processes in addiction, see Baker, Piper, McCarthy, Majeskie, & Fiore, 2004). In one field study, for example, smokers who were attempting to quit were given palm-top computers and at several randomly chosen times each day were prompted to report their self-efficacy to remain abstinent and their urges. Smokers tended to report unrealistically high self-efficacy ratings as long as they were not experiencing an intense urge to smoke. On occasions when they were experiencing intense cravings, however, their self-efficacy ratings dropped to more plausible levels (Gwaltney, Shiffman, & Sayette, 2005). Likewise, research has found that many smokers entering treatment report high confidence that they will quit successfully (i.e., abstinence self-efficacy; Gwaltney et al., 2005). According to the cold-to-hot empathy gap, potential quitters, who are typically affectively neutral at the time of initial assessment, should overstate their level of abstinence self-efficacy relative to their eventual outcome. Were initial perceptions of self-efficacy recorded in a craving state, which more closely approximates high-risk situations, they might prove more accurate in predicting quitting.

Finally, the cold-to-hot empathy gap suggests that smokers should be likely to make misinformed decisions about placing themselves in high-risk situations (e.g., parties where there will be a lot of smoking) if they are in a noncraving state while they make these decisions. The present data suggest that smokers likely will underappreciate the allure of smoking in these future situations and thus may be more inclined to place themselves at risk than if they were craving at the time they made these decisions.

In conclusion, data from this study suggest that the cold-to-hot empathy gap applies robustly to the craving associated with cigarette smoking. While in high-craving situations, individuals experience a range of perceptual and cognitive effects that place them at increased risk to smoke. But when not in a craving state, they have trouble imagining how such a state will feel or the power of the motivation to smoke that they will experience.

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