The Racing-Game Effect: Why Do Video Racing Games Increase Risk-Taking Inclinations?

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The present studies investigated why video racing games increase players' risk-taking inclinations. Four studies reveal that playing video racing games increases risk taking in a subsequent simulated road traffic situation, as well as risk-promoting cognitions and emotions, blood pressure, sensation seeking, and attitudes toward reckless driving. Study 1 ruled out the role of experimental demand in creating such effects. Studies 2 and 3 showed that the effect of playing video racing games on risk taking was partially mediated by changes in self-perceptions as a reckless driver. These effects were evident only when the individual played racing games that reward traffic violations rather than racing games that do not reward traffic violations (Study 3) and when the individual was an active player of such games rather than a passive observer (Study 4). In sum, the results underline the potential negative impact of racing games on traffic safety.

Keywords: *video games; racing games; risk taking; reckless driving; self-perception*

> They accept the full risk—as they saw it in their video games.
>
> David Millen, Los Angeles Police Department, speaking about rush-hour street racing (as cited on Spiegel Online, 2007)

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Over the past few years virtual driving and racing games have emerged as one of the top-selling products in the video and computer game industry. However, compared to first-person-shooter games (in which players partake in massive virtual killing sprees; Gentile & Gentile, 2008), very little psychological research has been dedicated to the impact of street-racing games on risk-taking inclinations and risk perception in road traffic (Fischer, Kubitzki, Guter, & Frey, 2007; Kubitzki, 2005, 2006). This is surprising given that these photo-realistic games often depict, and even reward, harmful, risky, and aggressive road traffic behaviors from a first-person perspective. Players typically drive at high speed through urban environments, crashing into other drivers, performing reckless overtaking maneuvers, intentionally killing pedestrians by driving over them, and destroying other cars by bumping into them (see the content of racing games such as Burnout, Need for Speed, or Grand Theft Auto). Preliminary evidence (Fischer et al., 2007) suggests that these types of games may promote risk-taking inclinations similar to how first-person-shooter games promote aggressive inclinations and behaviors (e.g., Anderson et al., 2004). The aim of the present research was to further explore this possibility, with a focus on clarifying the psychological processes underlying the effect of racing games on risk taking.

Video Game Research and Psychological Processes

Video game research has been predominantly carried out within the first-person-shooter genre. This line of research consistently shows that playing first-person-shooter games significantly increases aggressive cognitions, emotions, and behaviors (Anderson & Bushman, 2001, 2002; Anderson & Dill, 2000; Anderson et al., 2004; Bushman & Anderson, 2002). For example, participants who played violent video games (compared to those who played nonviolent video games) administered increased levels of noise blasts and electric shocks to other people (Anderson & Dill, 2000; Bartholow & Anderson, 2002; Bushman, 1998), reported increased levels of aggressive expectations in their environment (Bushman & Anderson, 2002), and showed decreased levels of prosocial behavior (Anderson & Bushman, 2001).

The effects of violent video games have been mainly explained by the general aggression model (GAM), which specifies processes of priming, imitation, and learning (cf. Anderson & Bushman, 2001; Anderson & Dill, 2000; Anderson et al., 2004; Bushman, 1998; Gentile & Gentile, 2008). According to Anderson and Dill (2000), GAM comprises a "multi-stage process by which personological (e.g., aggressive personality) and situational (e.g., video game play and provocation) input variables lead to aggressive behavior by influencing several related internal states and the outcomes of automatic and controlled appraisal (or decision) processes" (p. 773). In GAM terms, aggressive video games are thought to trigger aggressive ideas, which, via spreading activation (e.g., Bushman, 1998; Collins & Loftus, 1975), increase the accessibility of other aggression-related constructs, including aggressive cognitions, emotions, and behaviors (see also Berkowitz, 1984; Bower, 1981).

More recent research has also revealed that violent video games can alter one's automatic self-concept (i.e., the extent to which people automatically associate themselves with aggression; cf. Uhlmann & Swanson, 2004; see also Todorov & Bargh, 2002). For example, by using an implicit association test, Uhlmann and Swanson (2004) showed that playing violent video games fostered the development of spontaneous aggressive self-views, such as aggressive self-perceptions and self-beliefs. We assume that similar changes in self-perception play a crucial role in explaining the effect of racing games on risk-taking inclinations. In the next section, we review the previous research on video racing games and consider the extent to which the GAM can account for these effects.

Previous Research on Video-Racing Games and Risk Taking

Racing games are nearly as popular as first-person-shooter games. In these games players are reinforced for driving recklessly and systematically breaking traffic rules (Fischer et al., 2007). In response to the increasing incidence of street-racing and associated accidents in recent years (e.g., since 2000, authorities in California acknowledged about 50,000 incidences of illegal street racing; Spiegel Online, 2007; moreover, in 2005, California police departments received $1.2 million to fight illegal street racing; California Office of Traffic Safety, 2005), research interest has begun to focus on the effects of playing video racing games. Kubitzki (2005, 2006) assessed the link between racing game activity and car-related behaviors among adolescent males (13-17 years old). Seventy-seven percent of respondents reported playing racing games regularly, and there was a positive correlation between the intensity of racing game consumption and underage driving offenses. Moreover, in in-depth interviews, young males who were involved in illegal street racing reported that video racing games played a significant role in their personal development of attitudes and norms concerning risky driving behavior (i.e., driving-related socialization; Kubitzki, 2004).

More recent research by Fischer et al. (2007, Study 1) also found among 16- to 24-year-old participants significant correlations between the intensity of playing racing games on one hand and self-reported accidents, attitudes toward competitive driving, and attitudes toward obtrusive driving on the other. These effects were particularly strong among male participants. Additional experimental studies demonstrated the causal nature of the relationships. For example, playing a racing game for 20 min versus playing a nonracing, neutral game increased the accessibility of risk-promoting cognitions (e.g., interpreting target words in a risk-relevant direction) and emotions (e.g., excitement and arousal). Finally, male participants who played racing games were more likely to exhibit risk-taking behavior in videotaped critical road traffic situations as measured by reaction times (Vienna Risk Taking Test [WRBTV]; Schuhfried, 2006; for a detailed description of the WRBTV, see the Method section of Study 1). Additional studies (Fischer, Guter, & Frey, 2008) found that the effects of game playing on risky behavior extended beyond the driving domain, for example, by increasing risky financial decision making. In contrast, unpublished research by Vorderer and Klimmt (2006) found only a hint of an effect under specific circumstances of racing games on simulated driving behavior and thus concluded that racing games do not detrimentally affect risk taking. Vorderer and Klimmt used a driving simulator, which does not necessarily measure actual risk tolerance. However, a crucial difference in the Fischer et al. (2007) studies was the use of a specific risk-taking measure as the dependent variable.

To conclude, extant research on the effects of playing racing games suggests that playing can trigger risk-supportive cognitions and emotions, and thus it increases risk-taking behavior, both within and beyond the driving context. However, research in this area is in its infancy, and for several reasons there is a need for additional research. Principally, although there is some evidence for the negative effects of playing racing games (see previous discussion), Vorderer and Klimmt (2006) have found only limited and weak short-term effects of driving games on road safety, leading these authors to conclude that racing games have no substantial detrimental effect on road traffic safety. Thus, the size and longevity of racing-game effects remain unclear. Questions about the longevity of these effects are particularly pertinent for determining the real risk video racing games represent for actual road traffic behavior beyond the immediate context of playing a game.

Second, and most important for the present investigation, the underlying psychological processes behind racing games effects are still speculative. Fischer et al. (2007) suggested that priming processes might be responsible for the observed effects of game playing. Greitemeyer and Osswald (in press-a) found that the effect of prosocial video games on prosocial behavior was mediated by an increased accessibility of prosocial thoughts. Moreover, playing prosocial video games decreases aggressive cognitions (Greitemeyer & Osswald, in press-b). However, based on the GAM, a variety of alternative or additional explanations remain plausible. For example, playing racing games may increase risk taking because they (a) are more arousing (e.g., Fischer et al., 2007), (b) closely resemble reality (i.e., model learning; Bandura, 1971; Bushman, 1998), (c) lead to habituation to risky situations and thus reduced inhibition of risk-taking behavior (cf. Carnagey, Anderson, & Bushman, 2007), (d) increase aggressive tendencies (cf. Fischer et al., 2007), and (e) might alter risk-related self-perceptions (Uhlmann & Swanson, 2004) and thus increase tolerance for risky driving and breaking traffic rules in real road traffic. Although each of these explanations is consistent with the GAM, relative to other facets of the model they are less well researched in the domain of video game effects and in relation to racing games more specifically.

Racing Games and Self-Perceptions: The Present Research

To address the shortcomings of previous research, the aim of the present studies is to systematically investigate the causal effect of racing games on risk taking and to clarify the psychological processes behind these effects. Our main assumption is that racing games make players more comfortable with breaking traffic rules, which carries over to risk taking in real driving situations. Specifically, we focus on the role of changing self-perceptions in mediating the effects of game playing on risky behavior.

Although priming has been suggested to underlie racing-game effects (Fischer et al., 2007), the present research attempts to specify what is primed when individuals play racing games. The GAM identifies a broad variety of mechanisms that can be triggered by violent media content, such as aggression-related attitudes and beliefs, self-perceptions, and self-efficacy beliefs as well as a whole range of aggression-related knowledge structures (cf. Anderson & Dill, 2000; Anderson et al., 2004; Bushman, 1998). Recent research by Uhlmann and Swanson (2004) highlighted how exposure to violent video games can increase automatic associations between aggression and the self (see also Todorov & Bargh, 2002). By using an implicit association test, these authors showed that playing violent video games fostered the development of spontaneous aggressive self-views, such as aggressive self-perceptions and self-beliefs. We propose

that a similar process may be applicable to the domain of racing-game effects. That is, participants who play a racing game may develop automatic self-views that are in line with breaking traffic rules and reckless driving, which subsequently carry over to real road traffic situations.

For a number of reasons, changes to self-perceptions are particularly likely in response to video game playing. Unlike other forms of media (e.g., violent movies), video games have the unique attribute that players are extremely active with the game content (e.g., pressing buttons, controlling the game character with the joystick). This high activity level might lead to stronger effects on self-perceptions ("I am behaving recklessly because *I am* a reckless person") compared to other, more passively consumed types of media. In addition, video racing games are highly realistic. As such, it might be difficult for players to distinguish the game environment from real-world driving situations.

We conducted a series of four studies to investigate whether racing games increase risk taking in road traffic situations and whether this effect is due to altered self-perceptions of being a reckless driver and breaking traffic rules. To rule out potential demand effects, Study 1 was designed to investigate the racing game effect with increased psychological distance (i.e., increased time lag) between racing-game stimulus and the risk-taking measures. Study 2 aimed to test whether the basic racing-game effect was mediated by altered self-perceptions toward being a reckless driver. Study 3 manipulated whether game playing required participants to actively break traffic rules by assigning participants to play street-racing games (which reward road violations and accidents) versus Formula 1 (F1) games (which include much of the same imagery but reward accuracy instead of violations of road traffic rules) or nonracing games. We expected effects on risk taking only when game playing rewards road traffic violations. Finally, Study 4 directly manipulated whether the self was involved in breaking traffic rules by comparing racing game players (i.e., self involved) and racing-game observers (i.e., self not involved). We predicted that actually playing racing games (i.e., when the self is directly involved in the game content) should have the strongest effect on self-perceptions and thus the strongest effect on risky behaviors.

STUDY 1

To make sure that the racing game effect is *not* based on experimental demand, we conducted a first study in which we employed a time lag design. Concretely, to increase the distance between manipulating the independent variable and measuring the dependent variable, participants came to the lab on 2 subsequent days. On Day 1, we manipulated whether participants played a racing game or a neutral game for 30 min. About 24 hr later on Day 2, we measured their risk-taking inclination on the WRBTV. We expected that even after 24 hr the increased risk-taking inclination caused by racing games would still be observed.

Method

Participants and design. Thirty-six students from the University of Munich (LMU) participated in this study. Two participants were excluded because they failed to come to the second experimental session 1 day later, leaving 34 participants for the final sample (23 women and 11 men; age range = 21-48 years; $M = 26.73$, $SD = 6.21$). The study consisted of a single-factor design (type of game: racing vs. neutral) with risk-taking inclination as the dependent variable.

Materials and procedure. Participants were recruited on the campus of LMU and were paid 5 euro for their participation. Participants were told they would participate in two independent studies on 2 days: The first study (Day 1) would be concerned with assessing video games, and the second study (Day 2) would be concerned with testing new software for street safety. On Day 1, participants came into the experimental lab and played a racing game (Burnout) or a non-racing-related game (Tetris) for 30 min. Afterward, participants evaluated the game with regard to its arousal properties. Concretely, arousal was measured by a three-item scale (Fischer et al., 2007; Fischer et al., 2008) on which participants indicated to what extent they felt (a) aroused, (b) excited, and (c) experienced a "kick" as a result of playing the game on a scale from 0 (*not at all*) to 10 (*extremely;* $\alpha = .91$).

One day later, the same participants came back to the lab for an ostensibly unrelated study. In fact, our main dependent measure of risk taking was assessed. To this end, participants worked on the WRBTV (Schuhfried, 2006), which is a widely accepted and standardized measure used to assess risk taking. This test measures individuals' willingness to take risks in critical, dangerous road traffic situations based on their reaction times. It has been predominantly employed in traffic psychology. All participants sat in front of a computer screen and were informed that they would view 15 videotaped critical road traffic situations (short video clips) from the driver's perspective. These critical situations included, for example, overtaking maneuvers or arrival at railroad crossings that have already started to close down. First, the critical traffic situation was described by written text on the computer screen. Afterward, participants

viewed video sequences of the critical road traffic situations two times. The first time, participants were told only to observe the critical situation (i.e., they watched the whole situation to the end). The second time, participants decided when they would *abandon* their road traffic maneuver by pressing a key on the personal computer (PC) keyboard. The longer participants' reaction time (participants also could maximally never press any key and thus show maximal risk tolerance in a particular sequence), the higher was their inclination to take risk in the corresponding critical road traffic situation; thus, the time that elapsed between the start of the video sequence and the participants' decision to abandon their maneuver (by pressing a key) was used as the dependent variable. After participants abandoned one critical situation, the next critical situation was introduced. In sum, the main dependent measure was a continuous variable of how soon they pressed the keyboard button. Thus, earlier reactions represent less risk-taking inclination than later reactions. The whole testing procedure lasted about 10-15 min. Previous studies have established the reliability of this measure (e.g., Scheiblechner, 1985) and the ability of the test to discriminate between accident-free drivers and multiple-accident drivers (e.g., 89% accuracy in a study by Sommer, Arendasy, Schuhfried, & Litzenberger, 2005).

To further increase the psychological distance to the independent variable (i.e., type of game played 1 day before), the WRBTV was taken in another experimental lab, and participants were informed that they would test new software on road traffic security. Afterward, participants were thoroughly debriefed about the real aim of the research. Special care was taken to ensure that no participant left the lab with risk-promoting or other negative thoughts and feelings. Participants were informed about what we had found in previous studies, that is, that playing racing games significantly increases risk taking in simulated critical road traffic situations. No participant reported any negative feelings or concerns about the study. The same debriefing procedure applies to the following studies.

Results and Discussion

Risk taking in road traffic. An independent sample *t* test revealed that players of racing games ($M = 6.99$, $SD = 1.30$) were 1 day later marginally more inclined to take risks in critical road traffic situations than players of neutral games with no racing content ($M = 6.33$, $SD = 0.89$), $t(32) = 1.70$, $p < .10$, $d = 0.59$. Because this effect was in the expected direction on the basis of the results of our previous findings (Fischer et al., 2007), using a one-tailed test is appropriate. Under this condition the observed *p* value was below .05 and thus reached significance.

Background checks. Age and gender were not significantly associated with risk taking in road traffic. Racing games ($M = 5.09$, $SD = 2.25$) were assessed to be marginally more arousing than neutral games ($M = 3.68$, $SD = 2.00$), $t(32) = 1.93$, $p = .06$, $d = 0.66$. However, arousal did not mediate the effect of racing games on risk taking ($t < 1$).

In sum, Study 1 revealed that increased risk taking remains prevalent even 1 day after participants played the racing game. This result makes the alternative account less likely that the racing game effect on risk taking measured by the WRBTV is due to a demand effect based on temporal and psychological proximity of the independent and dependent variables.

STUDY 2

Study 2 was designed to provide a first test of our basic process argument. Specifically, we argue that when people play video racing games, they perceive themselves as more risk taking, leading to more positive attitudes toward reckless driving and increased risk-taking inclinations in road traffic. To test this logic, we had participants play either a street-racing game or a neutral game for 20 min. Afterward, their risk-taking inclination in critical road traffic situations was measured as well as their self-perception as a reckless driver. Finally, we assessed risk-taking behavior in a second task that required people to react to risks in critical, dangerous road traffic situations.

In Study 1, we showed that playing a racing game increased risk taking even when there was 1 day between playing the game and measuring risk taking. We did not directly compare the effect of this delayed measurement with an immediate subsequent measurement of risk taking. This was done in Study 2 with a shorter delay that could still be realized in a cross-sectional lab experiment. Our main hypothesis was that game playing increases risky behavior in a driving task (immediate subsequent as well as 15 min delayed) and that this effect is mediated through altered self-perceptions of being a reckless driver.

Method

Participants and design. Forty-one individuals participated in Study 2; 4 participants were excluded because they failed to complete the questionnaire (2 were in the racing-game condition and 2 were in the neutral-game condition). In addition, 6 participants did not finish the risk-taking measure because of a computer failure and thus were automatically not included in the data file. Four of these participants were in the racing-game

condition and 2 were in the neutral-game condition. This left 31 participants for the main analyses (16 women and 15 men; age range = 18 to 29 years; $M = 22.29$, $SD = 2.87$). Participants were randomly assigned to one of three conditions: neutral video game, racing game with immediate measurement of risk taking, or racing game with delayed measurement of risk taking.

Materials and procedure. Participants were recruited in the psychology department of LMU and asked whether they would be willing to participate in a study on testing computer games. If they agreed, they were led to the video game lab. The experimenter explained to the players how to play the game and observed/assisted for the first 5 min. Participants then played one of two racing games for 20 min (Need for Speed or Burnout) or one of two neutral, non-racing-related games (Tak or Tetris). Both racing games let participants race through cities against other computer gamers and required players to violate traffic rules to win (e.g., by crashing into other cars, driving on the sidewalk, or driving at high speed). All games were played on a Sony PlayStation 2 platform and a 72-cm TV screen.

Time delay was manipulated by having half of the racing game players wait for 15 min after playing before working on the risk-taking measure. During this time, participants were offered newspapers to read. Participants in the neutral-game condition and in the no-delay racing-game condition immediately completed the same risk-taking measure as in Study 1 (WRBTV).

Then, risk-promoting affect (arousal) was measured as in Study 1. Finally, we employed a measure for positive self-perception of being a reckless driver derived from Trimpop and Kirkcaldy (1997). To obtain sufficient reliability, in the final computations we used only the four items (of overall eight items) that showed significant intercorrelations. These items were: "I like to compare my driving skills with other drivers on the street"; "I like to be admired for risky overtaking manoeuvres"; "I like to impress people with my reckless driving skills"; and "I like to speed—especially with many people on board." Responses were given on a scale ranging from 0 (*not at all*) to 10 (*extremely;* $\alpha = .75$).

Results

Risk taking. Results are depicted in Figure 1. A planned contrast revealed that players of racing games with time delay (contrast weight: 1; $M = 7.66$, $SD = 1.20$) and without time delay (contrast weight: 1; $M = 7.13$, $SD = 1.21$) were more inclined to risk taking in the critical road traffic situation task than were players of neutral games (contrast weight: –2; $M = 6.60$, $SD = 0.75$), $t(28) = 2.21$, $p = .04$, $d = 0.80$. No significant difference was observed between the racing game conditions with and without time delay (contrast weights 1 and –1, respectively; neutral condition = 0), $t < 1.07$.

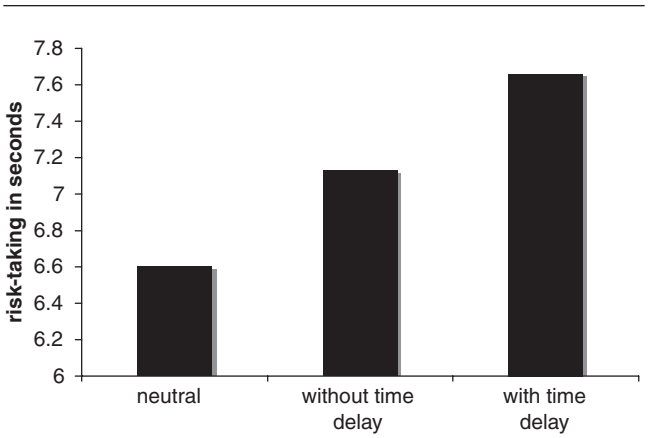

Figure 1 Risk taking as a function of type of game played and elapsed time (Study 2).

Self-perception as a reckless driver. A planned contrast revealed that players of racing games with time delay (contrast weight: 1; $M = 2.50$, $SD = 1.80$) and players of racing games without time delay (contrast weight: 1; $M = 1.91$, $SD = 1.76$) were more inclined to perceive themselves as reckless drivers than players of neutral games (contrast weight: –2; $M = 0.83$, $SD = 1.19$), $t(28) = –2.52$, $p = .02$, $d = 0.92$. No significant difference was observed between the racing game conditions with and without time delay (contrast weights 1 and –1, respectively; neutral condition = 0), $t < 1$.

Mediational analyses. To test whether self-perception as a reckless driver and/or arousal mediate the effect of the contrast on risk taking, a bootstrapping analysis based on 1,000 bootstraps was performed (Preacher & Hayes, 2008). Results showed a significant direct effect of the contrast on risk taking, $t = 2.20$, $p < .05$, which was reduced to nonsignificance, $t = 0.73$, $p = .47$, when controlling for the possible mediators (self-perception of being a reckless driver and arousal). Moreover, this analysis revealed a marginally significant mediation effect for self-perception of being a reckless driver, $t = 1.94$, $p = .06$, and a nonsignificant effect for arousal, $t = 1.11$, $p = .28$. Thus, the impact of racing games on risk taking was partially mediated by self-perception of being a reckless driver but not by arousal.

Background checks. There were no main effects or interactions involving age or gender on the dependent measures, all Fs < 1.36. Planned contrasts revealed that players of racing games with time delay (contrast weight: 1; $M = 3.50$, $SD = 2.74$) and players of racing

games without time delay (contrast weight: 1; $M = 4.38$, $SD = 1.47$) reported higher levels of arousal (i.e., risk-promoting affect) than players of neutral games (contrast weight: –2; $M = 2.11$, $SD = 1.63$), $t(28) = -2.62$, $p = .01$, $d = 0.95$. No significant difference in arousal was observed between the delay and the no-delay racing condition (contrast weights 1 and –1, respectively; neutral condition = 0), $t < 1$. Arousal was significantly correlated with risk taking ($r = .43$, $p = .02$).

Discussion

Study 2 revealed that players of racing games were more inclined to risk taking in critical road traffic situations than players of neutral games. As in Study 1, this effect did not immediately disappear but lasted for at least 15 min. Most important, we found initial evidence for our idea that self-perception of being a reckless driver (partially) mediates the effect of video game on risk taking. That is, it appears that playing racing games alters the players' self-concept: They perceive themselves as more reckless drivers, which in turn increases their proneness to risk taking.

To build on this evidence, we conducted a third study to test our assumption that it is the act of engaging in violations of road traffic rules (as part of the game) that is responsible for altering self-perceptions as a reckless driver rather than effects of arousal and aggressive competition that are also elements of such games. To do this, we manipulated whether playing the racing game involved breaking traffic rules.

STUDY 3

To directly manipulate self-perceptions of breaking traffic rules, Study 3 employed three conditions in which participants either played a typical street-racing game, an F1 game, or a neutral control game. If the active breaking of traffic rules is crucial for shifting self-perceptions and increasing risk taking, only games that reward breaking traffic rules should produce these effects. Accordingly, effects should only be observed in response to playing street-racing games (which reward rule breaking) but not in response to playing F1 games (which reward accuracy and speed only). In comparison, if the effect of racing games on risk taking is based on arousal, aggressive competition, or habituation to the driving scenario, rather than self-perception, effects should be equally apparent in the two experimental conditions.

Method

Participants and design. Fifty-nine individuals participated in Study 3. Four participants were excluded: Three failed to complete the questionnaire and 1 correctly guessed the aim of the study. Thus, 55 participants were left for the main analyses (28 women and 27 men; age range = 20 to 46 years; $M = 25.35$, $SD = 6.63$). Participants were randomly assigned to one of three experimental conditions: street-racing games, F1 racing games, or neutral games (without any racing content).

Materials and procedure. The procedure and cover story (i.e., testing computer games) were the same as in Study 2. To manipulate the independent variable, participants played one of two racing games for 20 min (Need for Speed or Burnout), one of two F1 driving games (F1 or Imola), or one of two neutral games (Tak or Tetris). The critical difference between the two racing game types is the type of driver behavior that is required to win. In the street-racer games, players race through cities against other gamers and must violate traffic rules to win (e.g., crashing into other cars, driving on the sidewalk, or driving at high speed). In the F1 games, players race around an F1 circuit, and to win they must complete the course faster than other players, but with *minimal* violations (i.e., not crashing cars or mounting the sidewalk). To control for arousal elicited by the different games, immediately after game playing we asked participants on a scale from 0 (*not at all*) to 10 (*extremely*) to what extent they found the game arousing and exciting. Both items were collapsed to an arousal scale ($\alpha = .82$).

As in the previous studies, the key dependent measure was risk taking in road traffic as assessed by the WRBTV. In addition, self-perception as a reckless driver was measured with the same four items as employed in Study 2 plus the following four additional items, which were employed to increase the focus on self-perceived driving behavior: "I like to participate in street racing"; "Normally, I respect speed limits" (reversed); "I fear driving too fast" (reversed); and "Sometimes I am afraid of causing an accident." Responses were given on a scale from 0 (*not at all*) to 10 (*extremely*). With all items combined, this formed a reliable scale ($\alpha = .68$).

Results

Risk taking. A planned contrast revealed that players of street-racing games (contrast weight: 2; $M = 6.95$, $SD = 1.44$) were more inclined to take risks in the simulated critical road traffic situations than players of F1 driving games (contrast weight: –1; $M = 5.88$, $SD = 1.25$) and neutral games (contrast weight: –1; $M = 6.06$, $SD = 1.24$), $t(52) = 2.65$, $p = .01$, $d = 0.74$. Players of street-racing games were also more inclined to risk taking than players of F1 driving games (contrast weights: –1 and 1, respectively; neutral condition = 0), $t(54) = 2.52$, $p = .02$, $d = 0.79$. The alternative orthogonal contrast comparing

players of F1 driving games (contrast weight: 1) and players of neutral games (contrast weight: –1; the racing game condition received the contrast weight 0) was not significant, $t < 1$ (see Figure 2).

Self-perception as a reckless driver. A planned contrast revealed that players of street-racing games (contrast weight: 2; $M = 3.26$, $SD = 1.43$) perceived themselves in more risky terms than players of F1 driving games (contrast weight: –1; $M = 2.48$, $SD = 0.99$) and neutral games (contrast weight: –1; $M = 2.46$, $SD = 1.26$), $t(52) = –2.29$, $p = .03$, $d = 0.62$. Players of street-racing games (contrast weight: 1) also perceived themselves in more risky terms than players of F1 driving games (contrast weight: –1; the neutral game condition received the contrast weight 0), $t(52) = –1.97$, $p = .05$, $d = 0.63$. The contrast comparing players of F1 driving games (contrast weight: 1) and players of neutral games (contrast weight: –1; the racing game condition received the contrast weight 0) was not significant, $t < 1$.

Mediational analyses. As in Study 2, we tested whether self-perception as a reckless driver and/or arousal mediated the effect of the contrast on risk taking. A bootstrapping analysis based on 1,000 bootstraps showed a significant direct effect of the contrast on risk taking, $t = 2.69$, $p < .01$, which was reduced to marginal significance, $t = 1.96$, $p = .06$, when controlling for the possible mediators. Moreover, although there was a significant mediation effect for self-perception of being a reckless driver, $t = 2.29$, $p < .05$, the effect for arousal was not significant, $t = 0.31$, $p = .75$.

Background checks. There were no effects of age on the dependent measures, $F < 1$, but there was a significant main effect of gender on risk taking (WRBTV) in which women were less inclined to risk taking than men, $F = 4.15$, $p < .05$. Importantly, gender did not interact with experimental condition, $F < 1$. A one-way ANOVA revealed no differences in reported arousal between street-racing games ($M = 4.03$, $SD = 2.16$), F1 games ($M = 4.42$, $SD = 2.12$), and neutral games ($M = 3.19$, $SD = 2.09$), $F(2, 52) = 1.51$, $p = .23$, $\eta^2 = .06$. Post hoc tests (LSD) also revealed no significant differences in arousal between street-racing and F1 games ($p > .56$) or between street-racing and neutral games ($p > .24$). A marginally significant difference in arousal was found between F1 and neutral games ($p < .10$).

Discussion

Study 3 revealed more risky behavior in simulated critical road traffic situations among players of street-racing games, relative to players of F1 games or neutral games. Thus, it is specifically games that reward traffic violations that increase risk taking rather than games that merely include any kind of racing content. Consistent with Study 2, this effect tended to be mediated through a change in self-perception as a reckless driver. After playing street-racing games, people saw themselves as more reckless and behaved in ways that were consistent with this self-perception on subsequent tasks. Given that playing F1 games had no effect on risk taking beyond the control condition, it appears that processes of competition, arousal, or perceptual risk habituation do not account for the negative effects of street-racing games—as these factors are equally present in both game formats. All these processes should be equally likely to occur in both street-racing games and F1 games.

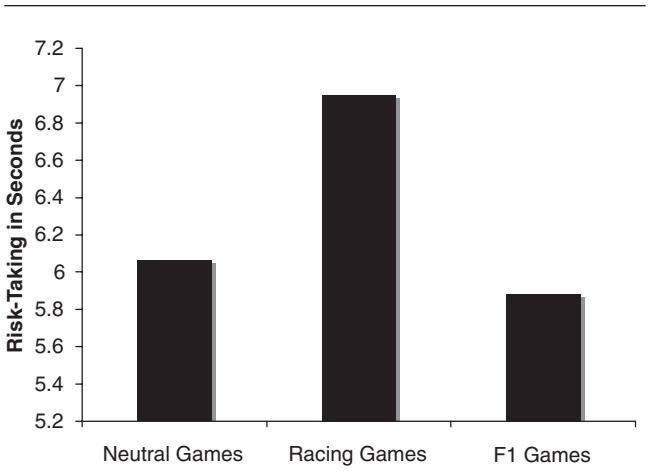

Figure 2 Risk taking as a function of type of game played (Study 3).

STUDY 4

Although Studies 2 and 3 provide support for our basic contention, we conducted a fourth study that directly tested our assumption that the racing-game effect is based on self-perceptions of breaking traffic rules. Actively playing video games has many implications for the self, especially from the perspective of self-management and learning (cf. Gentile & Gentile, 2008, pp. 128-130). For example, video games set forth clear objectives and players must continuously practice and adapt their game-relevant skills to meet the requirements of the game. Video games also provide immediate feedback to players and lead them step-by-step to self-serving experiences of mastering the requirements of the game content. Moreover, by inducing a multitude of repetitions (e.g., when the game character fails the player has to start again the same game sequence), video games lead to processes of "overlearning" and associated skill and knowledge automation (which facilitates

using game-relevant knowledge and skills in other situations). Finally, video games systematically reinforce the player's self-esteem on extrinsic (e.g., increased points, social status, or money in the game) and intrinsic (e.g., by inducing feelings of self-competence when specific aims of the games are successfully reached; cf. Gentile & Gentile, 2008, pp. 128-130) levels.

All of these self-relevant learning processes should occur when individuals *actively* play video games because the self is actually involved in the game. However, the same level of self-involvement should not occur when people simply observe another person playing the same video game. If self-perceptions of breaking traffic rules (and associated learning processes) are indeed responsible for the racing-game effect, these effects should only be apparent when people actively play but not when they passively observe racing games. This experimental logic is analogous to the logic of mediational analysis (Baron & Kenny, 1986). The mediator variable (i.e., self-perception of breaking traffic rules) should be connected to the dependent variable (i.e., risk taking in road traffic). That is, a direct manipulation of the mediator variable should lead to the same effect in the dependent variable as the usual manipulation of the independent variable (i.e., playing a racing game). In addition, if the effect of the mediator variable is statistically controlled for, the effect of the independent variable (type of game) on the dependent variable (risk taking) should be eliminated. In other words, if we "turn off" the self-perception of breaking traffic rules (i.e., by having participants only observe the game content but not letting them actively play), the effect of racing games on risk taking should be reduced. These patterns would directly show that self-perceptions of breaking traffic rules are the crucial psychological mediators of racing game effects.

To address this question, Study 4 directly manipulated whether the self is involved in breaking traffic rules. Half of the participants played either a street-racing or non-racing-related video game. The other half simply observed another participant playing either game type. The key difference between observing and playing the reckless driving scenes is that players have the self-perception that *they* are breaking traffic rules. Observers should have no corresponding self-perception of breaking traffic rules. If the self-perception of breaking traffic rules is a crucial psychological component of the racing-game effect, increased risk-taking inclinations should only occur when participants actually play a racing game instead of just watching another person playing it. In contrast, if traffic-rule-violating self-perceptions are less crucial compared to processes of perceptual habituation, model learning, or simple priming effects, it should make no difference whether individuals see the reckless driving scenes with or without a game controller in their hand.

Method

Participants and design. Sixty-four individuals participated in the experiment. Six participants were excluded: Three knew the hypotheses of the present experiment from participating in a previous similar experiment and 3 failed to complete substantial parts throughout the whole questionnaire (3 of these participants were in the racing-game condition and 3 were in the neutral-game condition). In addition, because of a computer failure 2 participants could not complete the WRBTV risk-taking test, but they completed all of the other risk-related dependent measures. Because of the broad variety of risk-related measures employed, the responses of these participants were included in the analysis of additional risk-taking effects. Thus, 56 participants remained for the main analyses, and 58 participants remained for analyses on additional effects (36 men and 22 women; age range = 20 to 47 years; $M = 32.19$, $SD = 8.64$). The study consisted of a 2 (type of game: racing vs. neutral) × 2 (type of activity: playing vs. observing) between-groups design. Participants were randomly assigned to one of the four experimental conditions.

Materials and procedure. The basic experimental procedure, technical equipment, and cover story (i.e., testing video games) were the same as in the previous studies, and the same video racing games (Need for Speed, Burnout) and neutral games (Tak, Tetris) were employed. Participants in the play condition actively played these computer games, whereas participants in the observe condition just watched other participants while they played. Players were told that the observers were the next players, and that observing would make it easier for them to learn to play the game. Separately, observers were told that they should concentrate on the scenes in the game. They were also told that they should assess the attractiveness of the game and that this was the reason why they would simply watch, rather than play, the games. The players played the game for 20 min. Afterward, both players and observers separately worked on the risk-taking dependent measure.

Then, as in the previous studies, the WRBTV was employed. After the risk-taking test, additional dependent variables related to risk taking were measured. First, participants' blood pressure was measured by a typical electronic measurement system. The experimenter noted the diastolic and systolic blood pressure values. Blood pressure is a physical indicator of arousal, which in turn is a central psychological construct in research on media effects (Anderson & Dill, 2000;

Zillmann, 1983), and arousal has been shown to be positively associated with risk-taking inclinations after consumption of risk-promoting media content (Fischer et al., 2007; Fischer et al., 2008).

Next, participants completed a series of measures designed to assess risk-related cognitions, emotions (arousal) and safe driving attitudes and norms. Based on aggression research (e.g., Anderson & Bushman, 2002), we measured accessibility of risk-related affect (excitement/arousal), risk-promoting cognitions, and general positive/negative emotions (to statistically control possible aggression-driven and mood effects). Accessibility of risk-promoting cognitions was measured by a homonymous decision task. Participants received a list of 10 words (e.g., *kick*) in which each word had two possible meanings (homonym): either a non-risk-related meaning (e.g., to *kick* a football) or a positively risk-related meaning (e.g., experiencing a *kick* as a result of stimulation through risky behavior such as fast driving). Participants were asked to define the word, and the absolute number of positively risk-related word definitions was employed as a measure of cognitive accessibility of risk-promoting ideas and cognitions.

Risk-promoting affect (arousal) was measured by a three-item scale on which participants indicated to what extent they felt (a) aroused and (b) excited and (c) experienced a "kick" as a result of playing the game on a scale from 0 (*not at all*) to 10 (*extremely;* $\alpha = .91$). Next, we measured self-perception as a reckless driver with a three-item short version based on the items of the previous studies.[1] Specifically, participants were asked to what extent they agreed (0 = *not at all,* 10 = *definitely*) with the statements: "I like to be admired for risky overtaking manoeuvres"; "Normally, I respect speed limits" (recoded); and "Basically, I fear driving too fast" (recoded; $\alpha = .42$). To control for mood effects (positive and negative emotions), after manipulation of the independent variable we employed the 10-item short version of the Positive and Negative Affect Scales by Watson, Clark, and Tellegen (1988). A measure of sensation seeking (Zuckerman, 1994) was also taken to control for this individual difference variable, which has been related to risky driving in past research. Finally, to check for potential confounding effects, general questions concerning participants' drivers' licenses and accident histories were asked.

Results

Risk taking in road traffic. The results are depicted in Figure 3. A priori contrasts revealed that players of racing games were inclined to take more risks in the simulated critical road traffic situations (contrast weight: 3; $M = 6.93$, $SD = 1.39$) than observers of racing games (contrast weight: –1; $M = 6.08$, $SD = 1.15$), players of neutral games (contrast weight: –1; $M = 5.98$, $SD = 1.17$), and observers of neutral games (contrast weight: –1; $M = 6.01$, $SD = 0.93$), $t(52) = 2.47$, $p = .02$, $d = 0.73$. More specifically, players of racing games ($M = 6.93$) exhibited a marginally significant stronger inclination for risk taking than observers of racing games ($M = 6.08$), $t(52) = 1.93$, $p = .06$, $d = 0.67$. Alternatively, no significant contrast was found when we compared the observers of racing games (contrast weight: 2) with players of neutral games (contrast weight: –1) and observers of neutral games (contrast weight: –1; players of racing games received the contrast weight 0), $t(54) < 1$. Finally, no significant contrast was found when we compared players of neutral games (contrast weight: –1) and observers of neutral games (contrast weight: –1; players and observers of racing games received the contrast weight 0 each), $t(54) < 1$.

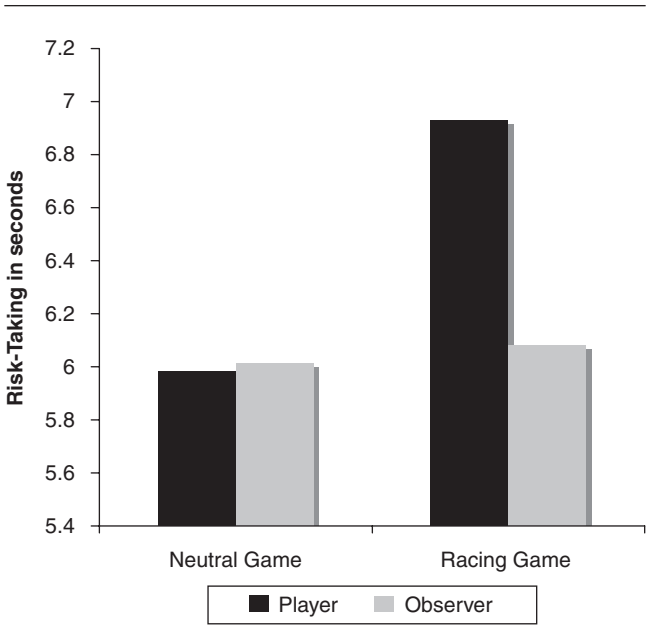

Figure 3 Risk taking as a function of type of game played (Study 4).

Self-perception as reckless driver. A priori contrasts revealed that participants who played a racing game (contrast weight: 3; $M = 4.74$, $SD = 1.94$) perceived themselves more as reckless drivers than observers of racing games (contrast weight: –1; $M = 4.10$, $SD = 1.92$), players of neutral games (contrast weight: –1; $M = 3.08$, $SD = 1.43$), and observers of neutral games (contrast weight: –1; $M = 3.20$, $SD = 1.36$), $t(54) = -2.46$, $p = .03$, $d = 0.70$. However, self-perception as a reckless driver did not mediate the impact of racing games on risk taking, $p = .62$.

Control for additional effects. Means and standard deviations for the additional variables are summarized in Table 1. As can be seen, players (contrast weight: 1)

TABLE 1: Risk-Related Effects of Playing and Observing Racing Versus Neutral Games in Study 4

	Experimental Condition							
	Racing Game				*Neutral Game*			
	Players		*Observers*		*Players*		*Observers*	
Risk-promoting cognitions	0.49	(0.20)	0.59	(0.26)	0.44	(0.18)	0.40	(0.23)
Risk-promoting emotions (arousal)	3.24	(2.59)	3.85	(2.94)	2.79	(1.40)	2.39	(1.75)
Negative affect	1.81	(0.80)	2.19	(0.85)	1.59	(0.47)	1.59	(0.47)
Sensation seeking	2.75	(0.36)	2.63	(0.55)	2.43	(0.52)	2.41	(0.33)
Systolic blood pressure	129	(21)	126	(17)	119	(14)	116	(13)

NOTE: The main effect for type of game was significant for all reported dependent variables (all *p*s < .05).

and observers (contrast weight: 1) of racing games reported higher levels of sensation seeking, $t(54) = 2.25$, $p = .03$, $d = 0.61$; accessibility of risk-promoting cognitions, $t(54) = -2.14$, $p = .04$, $d = 0.59$; risk-promoting emotions (arousal), $t(54) = -8.47$, $p < .001$, $d = 0.46$; negative affect, $t(54) = 2.61$, $p = .01$, $d = 0.62$; and systolic blood pressure, $t(52) = 2.21$, $p = .03$, $d = 0.60$, than players (contrast weight: –1) and observers (contrast weight: –1) of neutral games. For these effects we only found main effects for racing games versus the neutral game. We found no specific influence of playing versus observing racing games. That is, racing games—independent of whether they were played or observed—increased the measured levels of these variables compared to neutral, nonracing games. Regression analyses in which we simultaneously predicted risk taking on the WRBTV by the main contrast (playing racing games vs. all other groups) as well as potential mediating variables revealed no significant mediations: All betas of the main contrast stayed below the $p = .05$ level, and no beta of the potential mediators was below the $p = .05$ level.

Background checks. There were no effects of age or gender, all *F*s < 1.40. There were also no relations between risk taking (WRBTV) and accident history or duration of driver's license (all *r*s ranging between –.01 and .08, all *p*s > .20). Players and observers of racing games reported higher levels of arousal than players and observers of neutral games (see Table 1). However, this effect did not mediate the effect of playing racing games (vs. the three other conditions) on risk-taking inclination (see the Control for Additional Effects subsection).

Discussion

Study 4 revealed that playing racing games, as compared to observing racing games, playing neutral games, or observing neutral games leads to significantly increased behavioral risk-taking tendencies in simulated critical road traffic situations and a shift in self-perceptions of being a reckless driver. In contrast, for the remaining cognitive and affective risk-related variables, we found no specific effects of playing versus observing racing games. However, we observed a series of main effects for type of game (racing vs. neutral): Among players and observers of racing games, increased levels of risk-promoting cognitions, risk-promoting emotions (arousal), sensation seeking, negative affect, and systolic blood pressure were observed. These results make it less likely that arousal and negative affect might account for the racing game effect. Even though playing and observing racing games leads to similar arousal levels, only actively playing a racing game led to increased risk taking. In addition, perceptual desensitization is not a likely account for the racing game effect either, as it only occurred for players but not for observers of racing games—even though observers were visually exposed to the same racing environment as players of racing games.

An important limitation of Study 4 is that although players of racing games reported higher levels of self-perception as a reckless driver than all other conditions, this variable did not mediate the impact of racing games on risk taking in the WRBTV task. One reason for that might be the low reliability of the short version of self-perception as a reckless driver scale. Another reason might be that this short-version scale was more strongly related to adherence to traffic rules (e.g., respecting speed limits) than to positive self-perceptions as a reckless driver (e.g., being admired for risky driving). The latter items were mainly missing in the employed short version. Future research should disentangle norm adherence and self-perceptions in that context.

A further potential limitation of Study 4 is that it might be that players and observers have different psychological reasons for increased responses on the risk-taking measures. For example, players of racing games might report higher levels of risk-taking cognitions and blood pressure because they play a thrilling video game, whereas observers report increased levels on these variables because of anxiety resulting from not being in control in the reckless driving scenes.[2] Although we found no differences in negative affect between players

and observers of racing games (which would be expected if this alternative explanation is valid), future research should take up this question.

Overall, the results of Study 4 draw a more detailed picture of the impact of racing games on risk taking. Previous research (Fischer et al., 2007) has argued that the impact of racing games is driven by simple priming effects mainly due to increased accessibility of risk-promoting cognitions and emotions (arousal)—similar to the impact of aggressive video games on aggression (see also Fischer et al., 2008 for other risk-glorifying media stimuli). On the basis of the present data, this does appear to be the case. However, it is also not the whole story. Although we found no significant mediation (with the previously mentioned potential reasons), on the basis of the results in the main experimental design it is likely that another component in the racing game effect is the self-perception of breaking traffic rules, leading to increased associations between the self and the racing game content (i.e., breaking traffic rules and thus being a reckless driver). Only when participants played racing games (which systematically reward breaking of traffic rules) was risk taking in the subsequent main dependent measure increased (compared to the remaining three conditions). Although playing as well as watching reckless driving scenes affected a variety of risk-related measures including blood pressure, risk-related cognitions and emotions, and self-reported sensation seeking, it seems that the experience of actively breaking traffic rules (and an associated change in self-perceptions of being a reckless driver) is a necessary precondition for pushing individuals over the threshold, making them more inclined to actual risk taking on a behavioral level.

GENERAL DISCUSSION

The aim of the present research was twofold. Our first goal was to rule out that the basic racing game effect is simply due to demand elicited by the experimental setting. One could argue that participants saw our measure of risk taking (WRBTV) as just another video game and thus the instructions of the first video game (either racing or neutral) might still have influenced the risk-taking measure. However, because the risk-promoting effects of racing game playing were still apparent 1 day after game play (Study 1), we felt this was an unlikely alternative explanation.

More important, we tested why video racing games increase risk taking in critical road traffic situations. On the basis of the present studies, a considerable part of the answer to this question is: because they make the player actively break traffic rules, which leads to a more positive evaluation of reckless driving and increased self-perceptions as a reckless driver. Consistent with this, in Study 2 the increased risk taking of racing-game players (vs. non-racing-game players) was partially mediated by participants' increased self-perception as reckless drivers. In addition, Study 3 found that only street-racing games (which reward the player for frequent and massive violations of road traffic rules), but not F1 driving games (which do not reward the player for violating road traffic rules) resulted in increased risk-taking inclinations. Again, this effect was partially mediated by a positive shift toward greater self-perception as a reckless driver. Moreover, by directly manipulating whether the self is actively involved in breaking traffic rules, Study 4 found that only players (who actively break traffic rules) but not mere observers (who do not actively break traffic rules) of video racing game scenes exhibited increased risk-taking inclinations and a more positive attitude toward reckless driving. Interestingly, in no study did arousal mediate the effect of racing games on risk taking.

Implications, Limitations, and Future Research

The present research replicates previous research (e.g., Fischer et al., 2007) and thus broadens the empirical basis of the racing-game effect. This is particularly important given the somewhat mixed status of the literature on racing-game effects (e.g., Vorderer & Klimmt, 2006). Overall, the four studies consistently show increased risk-taking effects after racing-game exposure and thus put emphasis on the reliability and validity of the racing-game effect.

More important, the present research shows that these effects are partially linked to altered self-perceptions. After playing racing games, participants were more inclined to perceive themselves as reckless drivers (compared to playing a neutral game). This effect was mainly due to self-perceptions of systematically breaking traffic rules, which could be shown in two partial mediations (Studies 2 and 3) and one direct experimental manipulation (Study 4). Although the GAM covers these self-relevant processes in its basic assumptions (cf. Anderson & Bushman, 2001; Anderson & Dill, 2000; Bushman, 1998), the effects of video games on the self, as well as associated learning processes, are an underinvestigated area in video game research (cf. Gentile & Gentile, 2008). Hence, it would be fruitful for future research to further investigate the impact of a variety of video game content on behaviorally relevant perceptions of the self (e.g., in online role playing games or violent games)—especially because we only found weak mediation effects. The role of self-perceptions are particularly relevant to research on traffic safety because it is known that

traffic-related attitudes and self-perceptions codetermine traffic-related behaviors (e.g., Parker, Manstead, Stradling, & Reason, 1992a, 1992b).

Moreover, the fact that we only found partial mediation for changes in self-perception as a reckless driver, future research should try to detect other psychological processes underlying the effect of racing games on risk taking. Counterintuitively, arousal never mediated the racing game effect in the present studies, which would have been expected by previous findings on risk-taking effects (e.g., Fischer et al., 2007; Zuckerman, 1979). Therefore, the question is what further psychological processes might explain the racing-game effect. One candidate process might be that participants simply imitate what they see on the computer screen. Players of racing games with massive violations of road traffic rules might transfer the same behavior to other situations that are concerned with driving behavior. Future research could test this possibility by either directly asking whether participants intend to imitate the game content or, more implicitly, by designing a dependent variable that allows controlling for whether participants show similar reckless driving behavior (e.g., in a driving simulator or another driving game) as performed in the preceding racing game. Another potential psychological process might be that players are systematically rewarded for reckless driving in racing games. Future research could test this possibility by designing a racing game situation that either additionally rewards reckless driving or not (similar to Study 3 of the present article). Consequently, additionally rewarded players of racing games should show the highest levels of risk-taking inclination. In sum, future research should test further possible explanatory psychological processes for the racing-game effect because the present research showed that altered self-perceptions as a reckless driver are only part of the story.

Of applied relevance are our findings that the impact of racing games on risk taking can endure for at least 15 min after playing and may even continue for up to 24 hr. This implies that it is possible for players' increased tolerance for risk taking to have real-life driving consequences (e.g., within 15 min one can easily quit playing, leave the house, and drive a substantial distance with one's own car). Given this, it would be important for future research to investigate how this effect can be counteracted. For example, a first step to counteract the real-life consequences of the racing-game effect might be to restrict the placement of racing-game consoles in snack bars along the highway (which is indeed the case for many German Autobahn restaurants).

Although the results of these studies point to a consistent picture, it is important to acknowledge some limitations and point to possible directions for future research. We tried to approximate behavior through the use of video-based driving simulations, but the validity of this measure needs to be considered in future research. Encouragingly, Sommer et al. (2005) found that this measure correctly identifies 89% of accident-free drivers and drivers who have had multiple accidents, respectively (criteria validity: $R^2 = .636$). However, the need for additional, realistic behavioral measures is clear. In addition, it is an open question whether the game-playing settings in our experiments accurately reflect real-life gaming conditions. We used a 72-cm computer monitor, which is a common size in Germany and is often used by players at home as well. Thus, the game-playing setting was physically similar to real-life playing conditions. However, the social context of game play is likely to be different from that which occurs in the lab. At the very least, rather than playing alone, gamers are likely to play with each other. In addition, "real-life" gamers rarely play for only 20 min. Instead, they play repeatedly for many hours a week (see Gentile, Lynch, Linder, & Walsh, 2004). Finally, the present experiments mainly employed participants who were not heavy video gamers in real life. It would be a fruitful endeavor for future research to investigate the extent to which these differences between lab and real-life gaming situations might moderate the racing game effect.

In the present research, we showed that racing games increased risk taking. These effects may not be limited to using video games but may also extend to other media sources. For instance, previous research has shown that exposure to songs with violent lyrics increased aggressive affect and cognitions (Anderson, Carnagey, & Eubanks, 2003) and aggressive behavior (Fischer & Greitemeyer, 2006), whereas exposure to songs with prosocial lyrics increased prosocial affect, cognitions, and prosocial behavior (Greitemeyer, 2009, in press). Thus, it would be interesting to examine whether listening to risk-promoting song lyrics increases risk taking (e.g., in Germany there are several famous songs that glorify speeding with the car; e.g., "Gib Gas ich will Spass" by Markus).

Conclusion and Final Remarks

Principally, although most people seem to be against the playing of first-person-shooter games (especially when children and teenagers are the most numerous player group), the real-life impact of street-racing games on risk taking in actual road traffic seems to be neglected by researchers, politicians, and parents. Each tragic and disastrous rampage killing in public schools is generally followed by a harsh debate on the negative impacts of first-person-shooter video games. In contrast, these ideas are rarely debated in the context of driver games,

although more than 1,000 teenagers die each year on German streets and one fifth of all killed or injured people in road traffic are aged between 18 and 24 (although this age group does only count for 8% of all German inhabitants; cf. German Federal Statistic Council, 2006). We also know that most fatal accidents that are caused by young males are due to deviant and reckless driving behaviours, including risky driving, speeding, and competitiveness (Kubitzki, 2007), and these male teenagers are the main consumer group of video racing games (see Fischer et al., 2007). Hence, future research exploring the link between racing game playing and traffic accident rates appears warranted.

NOTES

1. Because we measured such an extensive list of risk-related variables in this study, we used as many short versions as possible to keep the questionnaires within an acceptable range for participants. A disadvantage of this is, of course, that scale reliability might decline.

2. We want to thank an anonymous reviewer for this important point.

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