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Severity of gambling problems modulates autonomic reactions to near outcomes in gambling

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ABSTRACT

Outcomes in gambling games cannot only be classified based on their valence (wins and misses) but also based on their closeness (near and full outcomes). The present study investigated autonomic responses (phasic heart period changes and skin conductance responses) to near and full outcomes on a wheel of fortune in a sample of males with different degrees of gambling problems. Near relative to full outcomes elicited increased interbeat intervals shortly after outcome presentation. Furthermore, participants with more severe gambling problems showed increased skin conductance responses following near relative to full outcomes as well as relatively smaller interbeat interval responses to near relative to full misses. The findings confirm different processing of near compared to full outcomes and altered processing of gambling outcomes with increasing severity of gambling problems.

1. Introduction

Near misses are miss outcomes that are close to a win (Reid, 1986). Previous research has shown that compared to full misses, near misses are rated as being closer to a win, and are more motivating but less satisfying (Clark, Lawrence, Astley-Jones, & Gray, 2009; Dixon & Schreiber, 2004). In a recent study we introduced narrow wins, i.e. the win counterpart of near misses, which may be defined as win outcomes that are close to a miss (Ulrich & Hewig, 2014).

Previous studies have shown that near misses are processed differently by participants with and without gambling problems. Chase and Clark (2010) showed that participants with higher scores on a screening questionnaire for problem gambling showed more activation in the midbrain to near misses than to full misses. Habib and Dixon (2010) showed that participants with more gambling problems showed more activation in win-related brain regions following near misses, whereas participants with few to no gambling problems showed more activation in loss-related brain regions. Dymond et al. (2014) found that near misses compared to full misses were followed by greater theta power increases in the MEG in several frontal and insular areas. Theta power changes in the right orbitofrontal cortex following near misses were positively correlated with gambling problems.

So far, no study has investigated the processing of narrow wins in problem or pathological gamblers, although some gambling games also include the possibility of winning narrowly (e.g. Black Jack; a player wins narrowly when his card value is one point higher than the card value of the dealer). However, some studies have examined related questions. Narrow wins represent outcomes that barely resulted in a positive outcome. As such, gambling trials resulting in narrow wins are related to risky choices with positive outcomes. Studies have shown that pathological gamblers react especially favorably to positive outcomes of a risky choice, as indexed by an increased reward positivity in the event-related potential of the EEG (Hewig et al., 2010; Oberg, Christie, & Tata, 2011).

Several studies have looked at physiological responses during gambling in pathological and problem gamblers. Most of these studies examined tonic physiological measures (e.g. skin conductance level, heart rate) for the entire period of gambling (e.g. Anderson & Brown, 1984; Carroll & Huxley, 1994; Diskin, Hodgins, & Skitch, 2003; Meyer et al., 2000; Meyer et al., 2004; Moodie & Finnigan, 2005). The results generally point towards increased physiological arousal during gambling compared to baseline, with some studies (e.g. Moodie & Finnigan, 2005; Meyer et al., 2004) pointing towards differences in arousal between different types

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of gamblers (e.g. problem and nonproblem gamblers; frequent and infrequent gamblers), with problem or frequent gamblers showing more arousal while gambling. Studies analyzing phasic physiological responses to discrete gambling outcomes are scarcer. Wilkes, Gonsalvez, and Blaszczynski (2010) showed that it is possible to measure phasic skin conductance and heart rate responses to outcomes on electronic gaming machines. They showed that wins compared to losses were followed by increased skin conductance responses in healthy subjects. In a later study, Lole, Gonsalvez, Barry, and Blaszczynski (2014) analyzed skin conductance in problem and nonproblem gamblers while they were playing on electronic gaming machines. They found that nonproblem gamblers showed increased skin conductance responses for wins compared to misses, whereas problem gamblers showed similar responses to both outcomes.

Several other studies have investigated phasic skin conductance and heart rate responses following near misses. Most studies found signs of increased phasic physiological arousal, indicated by increased skin conductance responses following near compared to full misses (Clark, Crooks, Clarke, Aitken, & Dunn, 2012; Clark et al., 2013; Dixon et al., 2011; Dixon, MacLaren, Jarick, Fugelsang, & Harrigan, 2013), whereas Lole, Gonsalvez, Blaszczynski, and Clarke (2012) found no significant differences between the two miss outcomes. Concerning heart rate and heart period changes, the results are more mixed, though. Clark et al. (2012) and Clark et al. (2013) report a biphasic heart rate response following the outcomes, with an initial decrease of the heart rate followed by a subsequent increase. In both studies, there were no differences in the initial decrease of the heart rate. Clark et al. (2012) found larger subsequent heart rate increases for near misses compared to both wins and full misses. Clark et al. (2013) reported slightly different results for the subsequent heart rate increase, with near misses showing a larger heart rate increase than wins, but no significant difference to full misses. Furthermore, the heart rate increase following near misses significantly predicted persistence in the gambling task, with smaller heart rate increases after near misses leading to increased persistence. Dixon et al. (2011) reported larger heart period increases (corresponding to heart rate decreases) for near compared to full misses. Based on the timing of the paradigm used by Dixon et al. (2011), the observed heart period increases might have been the first part of a biphasic heart rate response. Finally, Lole et al. (2012) found no differences between near and full misses in the elicited heart rate responses. Thus, while the skin conductance results point towards increased physiological arousal following near misses, the heart rate results are more mixed, with one study (Clark et al., 2012) showing greater subsequent heart rate increases, one study showing greater initial heart rate decreases in a biphasic heart rate response (Dixon et al., 2011) and two studies (Clark et al., 2013; Lole et al., 2012) finding no difference between near and full misses in the elicited heart rate responses. Three of the previously mentioned studies also investigated whether the amount of pathology in the gambling behavior correlates with physiological responses to near miss outcomes but did not find evidence for a relation (Clark et al., 2012; Dixon et al., 2011, 2013). The sample used in Clark et al. (2012) consisted of students and thus included only three subjects scoring in the problem gambling range of the South Oaks Gambling Screen (SOGS; score >2), with the rest scoring below the problem gambling range. Hence, a potential relation between gambling status and physiological responses to near misses might have been masked by the specific sample used.

In the current study, we wanted to further elucidate physiological responses to near and full outcomes and their potential relation to differences in gambling pathology. Thus, we recruited participants with a range of scores on gambling screening questionnaires and let them play on a wheel of fortune while skin conductance and heart period were measured.

We hypothesized that near outcomes of either type, as compared to the respective full outcomes, would lead to increased physiological responses, visible as greater skin conductance response amplitudes and an increased biphasic heart period response. Since previous studies on near misses have shown mixed results concerning whether the effect occurs in the initial heart period increase or subsequent heart period decrease, we did not have a specific hypothesis as to which component of the biphasic heart period response would show an effect. Based on the literature, it is conceivable that either the initial heart period increase, the subsequent heart period decrease or both components are more pronounced following near compared to full outcomes. Finally, we expected greater skin conductance response amplitudes and increased biphasic heart period responses (stronger initial heart period increase and/or stronger subsequent heart period decrease) to near outcomes in participants scoring higher on problem gambling screening scales.

2. Methods

2.1. Participants

50 Male participants were included in the current study. We focused on males only, since gambling problems show a higher prevalence for males than for females (Bundeszentrale für gesundheitliche Aufklärung (Federal Centre for Health Education), 2014; Erbas & Buchner, 2012). First, a pool of potential participants was recruited via advertisement in the job section of a local website. Applicants filled in an online questionnaire consisting of demographic questions (age, gender, handedness, education) and two screening instruments for pathological gambling (Kurzfragebogen zum Glücksspielverhalten, KFG, Petry, 1996; South Oaks Gambling Screen, SOGS, Lesieur & Blume, 1987). We aimed at including participants from a broader range of scores on the gambling screens in our final sample. Thus, we used the pool of potential participants to recruit about half of the final sample from people below and above the cutoff scores for pathological gambling in the screenings respectively (cutoff SOGS = 5, cutoff KFG = 16).[1] The final sample consisted of 50 participants (mean age = 27.78, SD = 9.12, Range: 18–56), 20 of whom had SOGS scores of 5 or greater and 21 of whom had scores of 16 or greater on the KFG. The mean score for SOGS was 3.82 (SD = 3.10), the mean score for KFG was 13.38 (SD = 8.05); correlation coefficient was r = 0.652. Further information on the number of regular gamblers and their favorite forms of gambling can be found in Table 1. Participants were paid 10 Euros for participation and received an extra 2 Euros for their performance in the wheel of fortune. The study was approved by the local ethics commission.

2.2. Paradigm: wheel of fortune

The wheel of fortune used in this study was similar to the one used in our EEG-study (Ulrich & Hewig, 2014). In every trial, participants had to place a bet on one of the two colors on the wheel of fortune. The wheel consisted of eight segments spanning 45° each, alternately colored orange and turquoise. At the beginning of each trial, the wheel spun at a constant speed. The spinning motion was created by displaying a series of pictures in rapid succession, thus creating the impression of a counter-clockwise motion of the wheel. 72 pictures were used, each showing a 5° change of the position of the wheel, relative to the previous picture. Each pic-

[1] Regular gambling was no inclusion criterion. The main focus in the recruiting process was to achieve a broad distribution of scores in the gambling screenings in the final sample of 50 participants. Thus, especially the participants in the lower range of scores on the gambling screenings also include non-regular gamblers.