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Punishment sensitivity and tension reduction: Exploring the potential influence of genetics on South Korean alcohol consumption

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Abstract: Aldehyde dehydrogenase 2*2 (ALDH2*2) is a genetically mutated enzyme that affects the liver's ability to break down acetaldehyde, resulting in immediate negative physical effects following alcohol consumption. This usually leads to reduced lifetime alcohol dependence rates among those with ALDH2*2. Paradoxically, while around 30% of South Koreans have ALDH2*2, they still maintain both high levels of alcohol consumption and dependence. Therefore, how the negative reactions to alcohol experienced by those with ALDH2*2 interact with the expected effects of alcohol and sensitivity to punishment is of interest. Four hundred and sixty South Korean university students were tested for the ALDH2 gene type and completed alcohol expectancy and sensitivity to reward/punishment measures. The results indicated that there are different predictors of alcohol consumption depending on gene type, with ALDH2*2 heavy drinkers exhibiting lower levels of SP and higher levels of tension reduction expectancy. These findings suggest that ALDH2*2 plays a central role in differences in motivation for alcohol consumption among South Koreans.

Subjects: Behavioral Sciences; Health and Social Care; Social Sciences

Keywords: alcohol; expectancy; ALDH2*2; South Korea; SPSR

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This team of researchers was brought together during Dr. Benjamin Mahoney's PhD studies. Dr. Mahoney is currently working at Soonchunhyang University where he is involved in projects researching ALDH2*2 as well as ESL education. Dr. Deborah Graham is a member of the Cairns Institute where among other things she works closely with the Mercy Foundation to help end homelessness among indigenous women. Dr. David Cottrell has a background in linguistic software development, and is more recently involved in research exploring the complexities of sensory encoding during a single experience or event. Dr. Kyung Yong Kim is the head of the International Relations Department at Deagu Health College where he creates and manages the English language programs run for the college students. Dr. Dongjun Jeong and Dr. Suhak Heo both work at Soonchunhyang University Hospital in Medical Department Research Division with specialization in genetic sampling.

PUBLIC INTEREST STATEMENT

This research suggests that when it comes to heavy drinking, it's mind over matter. East Asians tend to drink less and have fewer drinking-related health and social problems. This is linked to a hereditary condition that slows the body's ability to break down alcohol, where drinking leads to things like headaches, nausea, and dizziness. In South Korea however, alcohol consumption is on par with heavier drinking nations, despite around 30% of South Koreans having the condition.

The results of this paper suggest that the ability to withstand punishment can predict whether a person with this condition will ignore the negative side effects and get drunk. This suggests that when it comes to alcohol, people will try to keep up if they have the ability to withstand feeling sick, indicating that the mind is overriding the body when it comes to alcohol in South Korea.

1. Introduction

One of the notable features of alcohol consumption in South Korea is that intake is high (around 14 liters of pure alcohol per person over the age of 15, [World Health Organization (WHO), 2011]) despite a high prevalence of the enzyme aldehyde dehydrogenase 2*2 (ALDH2*2). This genetically mutated enzyme, which is present in 30–35% of East Asians, results in a number of unpleasant side effects when alcohol is consumed. Its presence is the most reliable genetic indicator of lower levels of alcoholism (Ball, 2007), and predicts lower drinking levels among Asian Americans (Hendershot, Collins, & George, 2009; McCarthy, Brown, Carr, & Wall, 2001). However, alcohol dependence rates in South Korea are as high as 22% of the male population in some rural areas (WHO, 2004). Research exploring this anomaly indicates that Korean Americans have a higher level of self reported tolerance to alcohol's effects (Duranceaux et al., 2008) when compared with Chinese Americans. Duranceaux et al. (2008) reported that these differences appear to go beyond genetic factors, and suggest social and psychological factors in South Korean populations may be influential. Therefore, investigating possible personality and psychological variables that may interact with ALDH2*2 to help maintain such high drinking rates in South Korea is the focus of the current research.

Individuals who have the mutant ALDH2*2 remain unable to break down ACD effectively. The resulting buildup of ACD causes several adverse side effects, including a flushed red face, stomach irritability, cardiovascular disturbance, nausea, drowsiness, and headaches (Agarwal & Goedde, 1992). While both the heterozygous (2/1) and homozygous (2/2) forms of the mutation are less effective at breaking down ACD than the more typical (1/1) enzyme, (Crabb et al., 1989, cited in Thomasson et al., 1991) they have different breakdown rates. Those with the homozygous gene have two ineffective alleles, causing an even greater buildup of ACD than occurs in those with the heterozygous (2/1) genotype. The different effectiveness of these enzymes appears to result in different lifetime alcohol dependence rates, where those with the ALDH2 (2/1) allelic combination are four times less likely to suffer alcohol dependence issues than those with ALDH2 (1/1), and those with ALDH2 (2/2) are six to seven times less likely to than those with ALDH2 (1/1) (for review, see Quickfall & el Guebaly, 2006).

The experience of a buildup of ACD may also have some positive psychological effects in addition to the negative physiological consequences, with research indicating that direct injection of acetaldehyde into the ventral tegmental area of the brain results in even greater release of dopamine than ethanol (Enrico et al., 2009). Furthermore, Hahn, Huang, Ko, et al. explored alcohol expectancy among problem drinkers in Taiwan and noted that alcoholics with the ALDH2*2 genotype reported greater tension reduction expectancy than those with the normal gene. Alcohol expectancy represents the expectations one has of the consequences of drinking alcohol, and has been shown to predict self reported alcohol consumption levels. Individuals with more positive alcohol expectancies (reporting descriptors such as, happy, confident, sociable) relative to negative expectancies (e.g. sick, tired, dizzy) are more likely to be heavy drinkers (Reich & Goldman, 2005). Thus, it is possible that in South Korea, the expectations of specific positive effects of alcohol consumption outweigh the negative experiences and reduce the impact of the buildup of ACD. There is evidence for just such an expectancy effect in South Korea, with a recent study reporting that negative expectancies (e.g. dizzy, sick, tired) did not predict drinks per occasion, suggesting that positive expectancies are a more reliable predictor of alcohol consumption in populations with a high prevalence of ALDH2*2 (Mahoney, Graham, Cottrell, & Kim, 2012). In fact, levels of negative expectancy did not differ between heavy, moderate, light and nondrinkers. This is unlike what has been reported with a North American sample (Reich & Goldman, 2005). Therefore, it is reasonable to expect that tension reduction expectancy will predict the drinking levels of those with ALDH2*2 mutations.

Given the negative effects of ALDH2*2, there must be some mechanism by which heavy drinkers with ALDH2*2 override the adverse reactions of the buildup of ACD, to experience the positive tension reduction effects. One possibility is that heavy drinkers with the less effective ALDH2*2 enzymes are less sensitive to the aversive effects of ACD, and are thus able to emphasize the positive tension reduction effects. Gray's (1987) theory of approach and avoidance provides one possible

mechanism. Gray proposed that the motivation to engage in behaviors such as alcohol consumption is a tradeoff between two cognitive systems. The Behavioral Inhibition System (BIS) is a motivational system initiated to avoid negative affect arising from past experiences associated with punishing outcomes. In contrast, the Behavioral Activation System (BAS) regulates responses based on prior environmental events followed by rewarding outcomes through the activation of positive affect. Thus, South Korean heavy drinker's behavior might be the result of greater activation of the BAS than the BIS in response to alcohol consumption cues.

The relative importance of these two systems to an individual has been measured by the Sensitivity to Punishment and Sensitivity to Reward Questionnaire (SPSRQ) short form (Cooper & Gomez, 2008), asking 24 questions such as "Do you do things to be praised?" Although the SPSRQ is not a direct alcohol measure, Kambouropoulos and Staiger (2001) demonstrated that in a Western sample those individuals high in sensitivity to reward tend to respond faster to alcohol-related cues. O'Connor and Colder (2005) also reported that consumption patterns correlate with approach and avoidance personality traits, where Western heavy consumers are likely to be more sensitive to reward. Given that South Korean heavy drinkers have a similar level of negative expectancy to lighter drinkers, sensitivity to punishment is likely to be low. Hence, it is hypothesized that, to withstand the punishing effects of the build-up of ACD, heavy drinkers with ALDH2*2 are likely to be lower in sensitivity to punishment (SP).

Therefore, the aim of the current research is to investigate sensitivity to punishment and reward in conjunction with alcohol expectancies and ALDH2*2 genotype, and their relationship to alcohol consumption in South Korean drinkers. It is hypothesized that heavy drinkers with the heterozygous ALDH2 (2/1) genotype will be lower in sensitivity to punishment to allow them to withstand the high levels of acetaldehyde. Based on past research, it was also predicted that ALDH2 (2/1) heavy drinkers will exhibit higher levels of tension reduction expectancy than ALDH2 (2/1) lighter drinkers.

2. Method

2.1. Participants

The 460 participants (53.5% female) were recruited from Daegu Health College and came from four different departments: nursing, radiologic technology, dental hygiene, and pathology. The average age of the group was 20.8 years (SD = 2.8). Ethics approval for both the genetic testing and surveying was granted by both Daegu Health College and the Korean Department of Health. The participants originated from all parts of South Korea. It must be noted that while this demographic is not an exact reflection of the total Korean population (for example, younger South Korean women drink at higher rates than their older counterparts WHO, 2011), Korea has the second highest university attendance rates in the world (Korean National Statistics Office, 2009), which tends to suggest it is a good representation of younger Koreans.

2.2. Measures

2.2.1. Demographic survey

Along with their gender and age, the subjects were encouraged, via an example, to list how much of a particular drink they drank during a typical drinking occasion. The type of drink was then used to estimate the volume of alcohol consumed. The reported standard drinks per occasion was then calculated using the UK standard of 10 mls of alcohol (International Center for alcohol policies, 1998) per standard drink. Drinks per occasion was used because this measure is said to be a better indicator of dangerous alcohol-related incidents, such as drunk driving (International Center for alcohol policies, 1998).

2.2.2. Korean alcohol expectancy questionnaire (AEQ)

Alcohol expectancies were measured using a Korean adaptation of the Alcohol expectancy questionnaire (Brown, Goldman, Inn, & Anderson, 1980). The original AEQ consisted of 120 questions,

with 69 items that are scored. In their review of alcohol expectancy research, Goldman, Brown, Christiansen, and Smith (1991) argued that the development of AEQ items should rely on words generated in previous free-association tests. To this end, the Korean words generated by the statement "alcohol makes me…" in a South Korean alcohol free-association test (Mahoney et al., 2012) were used as a guide by those translating the AEQ. Here, the translator was instructed to use the words from the South Koran expectancy list where appropriate. For example, the word "dizzy" has two Korean words that perhaps could have been used. Here, the translator was asked to reference the list of Korea alcohol expectancies when translating feeling toward alcohol. Back translation was used, which required a translator to translate the English version into Korean before a different translator translated the Korean version back into English. The two English versions (the original and the back translated) were then compared. A committee consisting of three psychology professors and a Korean professor fluent in English assessed differences in the two questionnaires before re-submission to an independent translator for final approval. Past research has used this translation technique to produce valid psychometric tools (Lardi, Billieux, d'Acremont, & Ven der Linden, 2008).

The AEQ items were divided into 6 independent expectancy categories: Global Positive Expectancies (28 questions related to alcohol-changing experiences in a variety of positive ways), Sexual Enhancement (7 questions), Enhancement of Physical and Social Pleasure (9), Creation of Positive and Socially Assertive Personality Changes (11), Relaxation and Tension Reduction (9), and Increased Arousal and Aggression (5). All questions required just a yes or no answer, for example "alcohol makes me more interesting" (Global Positive Expectancy). The expectancy score for each category was the number of "yes" responses.

2.2.3. Sensitivity to punishment and reward questionnaire (SPSRQ)

A short version of Torrubia, Avila, Molto, and Caseras (2001) SPSRQ was translated for the purpose of this study using the same back translation technique (Cooper & Gomez, 2008). All 24 questions of the shortened SPSRQs also require a yes or no response. The score on each subscale is the number of "yes" responses.

2.3. Procedure

The testing took place in a classroom devoid of implicit alcohol cues (e.g. alcohol advertising) and occurred at the end of each group's first English language class. A Korean translator explained all the details and requirements. The students were informed by the translator that if they felt like leaving they could do so at any time. During the surveying period, participants were required to go to a nearby bathroom (in groups of five) and rinse their mouths using filtered water, while the remainder of the class attended to their surveys. The students were then asked to administer the buccal swab themselves, where they simply removed the swab from the casing, swabbed their mouth for 30 s, placed the swab back inside the casing, and reattached the lid (for extraction, see ALDH2*2 genotyping section below). The subjects were given a random number to record on their genetic sample, the demographic survey, and both tests so that the data could be matched.

2.3.1. DNA extraction (As performed by the Soonchunhyang genetics research team)

BuccalAmp™ DNA Extraction Kits (WI, USA) were used according to the manufacturer's instructions. The end of the Catch-All™ Sample Collection Swab was placed in the tube containing QuickExtract DNA Extraction Solution and rotated a minimum of five times. The swab brush was then pressed against the side of the tube and rotated while removing it from the tube to ensure most of the liquid remained. After screwing the cap on the tube tightly, vortexing occurred for ten seconds, followed by incubation at 65°C for 1 min, before vortexing again for fifteen seconds, incubating at 98°C for two minutes before finally vortexing again for fifteen seconds. The quantity and quality of DNA in the tubes was measured by NanoDrop (USA).

2.3.2. Real-time polymerase chain reaction (PCR) to differentiate wild type and mutant type

The ALDH2 wild type and mutant type were differentiated by real-time PCR using Cycleave Human ALDH2 Typing Probe/Primer Set (Takara, Japan) and Cycleave PCR Core Kit (Takara, Japan). Both positive (using the supplied ALDH2 positive control) and negative (sterilized distilled water) control reactions were conducted at the same time as the samples to verify that the processes had been adhered to.

For the following reaction, the mixture was prepared in a reaction tube on ice: 10X Cycleave PCR Buffer 2.5 µl, Mg^{2+} solution (25 mM) 3 µl, dNTP mixture (2.5 mM each) 3 µl, ALDH2 PCR Primer Mix 1 µl, Takara Ex Taq HS (5 units/µl) .25ul, TliRNase H II (200 units/µl) .5 µl, template DNA 1–13 µl containing 20–60 ng and adjusted total volume of 25 µl by adding dH_2O. The reaction was duplicated per sample and run in the real-time PCR machine, Exicycler™ 96 (Bioneer, South Korea). The real-time PCR condition was as follows: initial denaturation at 95°C for ten seconds, followed by 45 cycles of 95° for five seconds, 55°C for fifteen seconds, and 72°C for fifteen seconds. The mutant and wild alleles were evaluated by the real-time PCR curves according to the manufacturer's instructions, and the amplified curve was evaluated as mutant, wild, and heterozygous respectively.

3. Results

Mean reported standard drinks per occasion for the whole sample was 8 (*SD* = 5.1), with males reporting greater consumption $t(447)=-6.850$, $p < .001$ (see Table 1). Of the 460 participants, 324 were of the wild ALDH2 (1/1) genotype, 128 were heterozygous (2/1), and 8 homozygous (2/2). Those with ALDH2 (1/1) averaged 8.3 (SD = 5.0) drinks per occasion, (2/1) 7.5 (SD = 5.3), and ALDH2 (2/2) 5.9 (SD = 5.9). Given that there were so few ALDH2*2 (2/2) participants, (*N* = 8), only ALDH2 (1/1) and ALDH2 (2/1) types were included in the subsequent analyses. Independent sample *t*-tests with Bonferroni adjustment for multiple comparisons indicated that overall, there was no significant difference in alcohol consumption between the ALDH2 (1/1) and ALDH2 (2/1) participants, $t(450) = 1.425$, $p = .15$. There were also no significant differences between ALDH2 (1/1) and ALDH2 (2/1) in any alcohol expectancy categories, SP or SR (see Table 2).

A series of stepwise regression analyses were conducted to explore whether ALDH2*2 genotype, alcohol expectancies, SP or SR predicted drinks per occasion. As gender has been shown to have a significant influence over alcohol consumption in this and other South Korean samples (WHO, 2011), gender was added at the first step. This was followed by ALDH2*2 type at the second step, which was hypothesized to be contributing to the relatively high levels of negative expectancy found among heavy drinkers in Mahoney's et al. (2012) alcohol expectancy free association results. The expectancy categories were entered third, before SP/SR fourth, as past research had shown that SP/SR only predicts drug consumption levels when mediated by expectancy (Simon & Arens, 2007).

Gender, ALDH2*2 type, positive global expectancy, and SP were all significant predictors of alcohol consumption (drinks per occasion) in this South Korean sample (see Table 3). The positive ß for gender indicates that males drank more than females. Gender alone accounted for 9.5% of the variance in alcohol consumption. The negative ß for ALDH2*2 indicates that those with the gene for the less effective enzyme drank fewer drinks per occasion (i.e. the ALDH2 (1/1) types drank more than the

Table 1. Standard drinks per occasion (10 mls of alcohol) as a function of sex and ALDH2 genotype

	Mean	SD	*p*	*n*
Males	9.7	5.6	.001	216
Females	6.5	4.1		244
ALDH2 (1/1)	8.25	5.02	.658	324
ALDH2 (2/1)	7.49	5.32		128

Table 2. Means for each alcohol expectancy category and sensitivity to punishment and reward for each genotype

Alcohol expectancy	Genotype	Mean	SD	*p*
Global positive	ALDH2 (1/1)	11.40	5.76	.101
	ALDH2 (2/1)	10.18	5.12	
Sexual enhancement	ALDH2 (1/1)	1.12	1.73	.240
	ALDH2 (2/1)	1.05	1.42	
Physical and social	ALDH2 (1/1)	5.85	2.01	.930
	ALDH2 (2/1)	5.28	1.97	
Positive social assertive	ALDH2 (1/1)	6.68	2.85	.472
	ALDH2 (2/1)	6.14	2.91	
Relaxation	ALDH2 (1/1)	5.14	2.11	.141
	ALDH2 (2/1)	4.74	1.98	
Arousal and aggressive	ALDH2 (1/1)	2.48	1.21	.232
	ALDH2 (2/1)	2.59	1.10	
SP/SR				
Sensitivity to punish	ALDH2 (1/1)	8.09	3.21	.249
	ALDH2 (2/1)	7.94	3.34	
Sensitivity to reward	ALDH2 (1/1)	5.74	1.83	.982
	ALDH2 (2/1)	5.64	1.87	

ALDH2 (2/1) types) when the effect of gender was removed. However, genotype accounted for only an additional .5% of the variance, indicating that it was not a major determinant of drinking behavior. The addition of the expectancies at the third step accounted for an additional 6.3% of the variance, but the only specific expectancy related to alcohol consumption was global positive expectancy. That is, those that expected general positive outcomes from drinking tended to drink more. Relaxation and tension reduction was not related to alcohol consumption. With the addition of SP and SR to the equation, only SP was significantly related to consumption, with the negative ß for SP indicating that those with lower sensitivity to punishment tended to drink more on each drinking occasion. This final model accounted for around 17.5% of the variance, $F_{(10, 440)} = 10.535$, $p < .001$, but SP and SR accounted for only an additional 1.2% of the variance.

3.1. Analysis of each genotype

To gain a better understanding of the potential differences in motivation to drink between those with the different ALDH2 genes, the sample was split by ALDH2*2 genotype. Again, due to the infrequency of ALDH2 (2/2) types in the sample, only those with the ALDH2 (1/1) and ALDH2 (2/1) genes were analyzed.

3.1.1. ALDH2 (1/1)

A three-step regression analysis was performed with drinks per occasion as the dependent variable, while the independent variables were entered as follows: gender first, all six expectancy categories second, and SP/SR third. The rationale for this order is the same as outlined in the previous section. Gender was the best predictor of drinks per occasion (step 1 Table 4) accounting for 9.7% of the variance. Alcohol expectancies accounted for an additional 6.6% of the variance, and as with the overall sample, global positive expectancy was the only expectancy type to significantly predict consumption. Neither sensitivity to punishment or reward was a significant predictor of consumption. The final model accounted for 17% of the variance, $F_{(7, 316)} = 8.335$, $p < .001$.

Table 3. Summary of stepwise linear regression analysis of the ALDH2 (1/1) and (1/2) participants with gender, ALDH2 type, expectancy categories, and sensitivity to reward and punishment predicting drinks per occasion

Variable	*B*	*SE B*	*β*	R^2	ΔR^2
Step 1				**.097*** **	
Gender	3.19	.46	.31***		
Step 2				**.104*** **	**.008***
Gender	3.26	.46	.32***		
ALDH2	−1.01	.51	−.09*		
Step 3				**.178*** **	**.07*** **
Gender	2.66	.47	.26***		
ALDH2	−.60	.50	−.05		
Expectancies					
Global positive	.20	.08	.22*		
Sexual enhancement	.18	.17	.06		
Physical and Social	.22	.15	.09		
Positive social assertiveness	−.06	.12	−.04		
Relaxation	.00	.15	.00		
Arousal/aggressive	−.10	.23	−.02		
Step 4				**.193*** **	**.02***
Gender	2.60	.47	.25***		
ALDH2	−.61	.50	−.05		
Expectancies					
Global positive	.20	.08	.21		
Sexual enhancement	.10	.17	.03		
Physical and social	.18	.15	.07		
Positive social assertiveness	−.03	.12	−.01		
Relaxation	.01	.15	.00		
Arousal/aggressive	−.12	.23	−.03		
Sensitivity to punishment	−.15	.07	−.09*		
Sensitivity to reward	.21	.13	.07		

Note: Gender is coded 1 for female and 2 for male. ALDH2 is coded 1 for (1/1) and 2 for (2/1).

*$p < .05$.

**$p < .01$.

***$p < .001$.

3.1.2. ALDH2 (2/1)

An identical three-step regression analysis was performed on the ALDH2 (2/1) subgroup (see Table 5). As in the prior regression analyses, gender was a significant predictor of alcohol consumption accounting for 9.7% of the variance. Unlike the prior analyses however it was not the most important predictor, with alcohol expectancies explaining 13.7% of the variance. Again, contrary to the ALDH2 (1/1) results, global positive expectancies of alcohol consumption did not significantly predict drinking in this subgroup. However, an expectation that alcohol would have a relaxation/tension reduction effect did. Similarly, there was a significant negative relationship between expectations of arousal/aggression and alcohol consumption. Thus, for this subgroup, which suffers the negative effects of ACD buildup, alcohol consumption is related to the expectation that drinking will have a relaxing, non-arousing effect. This is also the group in which we expected heavy drinkers to display less sensitivity to the negative effects of ACD, which is consistent with the significant negative

Table 4. Summary of stepwise regression analysis of the ALDH2 (1/1) group with gender, expectancy categories, and sensitivity to reward and punishment predicting drinks per occasion

Variable	*B*	*SE B*	β	R^2	ΔR^2
Step 1				**.10*** **	
Gender	3.19	.53	.32***		
Step 2				**.18*** **	**.08*** **
Gender	2.63	.55	.26***		
Expectancies					
Global positive	.25	.10	.28*	.307	
Sexual enhancement	.07	.19	.02	.198	
Physical and social	.18	.17	.07	.099	
Positive social assertiveness	−.05	.14	−.03	−.065	
Relaxation	−.28	.17	−.12	−.266	
Arousal/aggressive	.25	.26	.06	.125	
Step 3				**.19*** **	**.01**
Gender	2.56	.55	.25***		
Expectancies					
Global positive	.25	.10	.29**		
Sexual enhancement	.02	.19	.01		
Physical and social	.15	.17	.06		
Positive social assertiveness	−.03	.14	−.02		
Relaxation	−.30	.17	−.13		
Arousal/aggressive	.22	.27	.05		
Sensitivity to punishment	−.12	.08	−.07		
Sensitivity to reward	.20	.15	.07		

Note: Gender is coded 1 for female and 2 for male.

*$p < .05$.

**$p < .01$.

***$p < .001$.

relationship between sensitivity to punishment and drinks per occasion. The final model accounted for 26% of the variance, $F_{(9, 126)} = 5.956$, $p < .001$.

4. Discussion

When the sample was broken down by genotype, there were both similarities and marked differences in the factors predicting alcohol consumption, and the strength of these relationships. For both groups gender was a significant predicator accounting for 9.7% of the variance. As with previous studies, males drank significantly more than females. When the effect of gender was controlled, there were marked differences in the relationship between the expectancies associated with alcohol consumption and the number of standard drinks consumed in a sitting. For those with the ALDH2 (1/1) genotype, alcohol expectancies accounted for an additional 6.6% of the variance with "global positive expectancies" being the only category of expectancy to significantly predict consumption. In contrast, in the ALDH2 (2/1) group, expectancies accounted for 13.7% of the variance, making these cognitive factors an even better predictor of consumption than gender. The categories of expectations related to consumption also differed from the ALDH2 (1/1) group. "Global positive expectations" was not a significant predictor of consumption. However, those with greater "Relaxation and tension reduction" expectations were more likely to drink more than those with lower levels, while those with greater "Arousal/aggressive" expectations were more likely to consume less. There were also differences in the relationship between sensitivity to punishment and reward and alcohol

Table 5. Summary of stepwise regression analysis of the ALDH2 (2/1) group with gender, expectancy categories, and sensitivity to reward and punishment predicting drinks per occasion

Variable	*B*	*SE B*	β	R^2	ΔR^2
Step 1				**.10*** **	
Gender	3.44	.902	.32***		
Step 2				**.28*** **	**.17*** **
Gender	2.68	.864	.25**		
Expectancies					
Global positive	.22	.142	.21		
Sexual enhancement	.32	.339	.08		
Physical and social	.13	.303	.05		
Positive social assertiveness	−.15	.233	−.8		
Relaxation	.82	.291	.31**		
Arousal/aggressive	−1.36	.458	−.28**		
Step 3				**.31*** **	**.04***
Gender	2.74	.856	.26**		
Expectancies					
Global positive	.16	.142	.15		
Sexual enhancement	.01	.365	.003		
Physical and social	.08	.299	.03		
Positive social assertiveness	−.01	.236	−.004		
Relaxation	.93	.289	.35**		
Arousal/aggressive	−1.38	.458	−.29**		
Sensitivity to punishment	−.26	.133	−.17		
Sensitivity to reward	.27	.258	.09		

Note: Gender is coded 1 for female and 2 for male.

*$p < .05$.

**$p < .01$.

***$p < .001$.

consumption between the two groups. Alcohol consumption was not related to sensitivity to punishment or reward in the ALDH2 (1/1) group. However, in the ALDH2 (2/1) group, heavier consumption was associated with lower sensitivity to punishment. This is in contrast to past research (Kambouropoulos & Staiger, 2001; Simon & Arens, 2007), which has shown that heavy drinkers are likely to display higher sensitivity to reward, there was no significant relationship between sensitivity to reward and alcohol consumption in the ALDH2 (2/1) subgroup.

Thus, those with ADLH2 (2/1) who drink at higher levels, despite the large concentrations of ACD, are more likely to be males who report lower levels of SP and higher levels of tension reduction expectation. They also are more likely to report lower expectations of arousal/aggressive responses, which potentially overlap with the relaxation and tension reduction expectation. A heavier drinker in the ALDH2 (1/1) group is also likely to be male, but their expectations of the effects of alcohol are more likely to be "globally" positive. Thus it is possible that heavier drinking South Koreans with the (2/1) enzyme, who drink despite the negative physiological consequences, are less sensitive to these negative effects, and are drinking to alleviate other negative stimuli (anxiety and arousing emotional states). In contrast, those with the (1/1) enzyme, who do not suffer such physiologically induced negative states, are drinking because they expect some positive outcome from doing so rather than the removal of a negative state. That a tension-reduction expectancy was shown to predict drinks per occasion for those with ALDH2 (2/1), but not the wild (1/1) genotype, which is

consistent with past research that indicates that alcoholics with the (2/1) enzyme have higher levels of tension reduction expectancy.

In regard to ALHD2 (1/1), the results are largely in line with previous research that suggests higher levels of positive expectancy correlate with higher levels of alcohol intake (Brown et al., 1980; Cranford, Zucker, Jester, Puttler, & Fitzgerald, 2010; Goldman et al., 1991; Gunn & Smith, 2010; Miller, Smith, & Goldman, 1990; Park, Kim, Kim, & Sung, 2007; Reich & Goldman, 2005). This is the group which is physiologically most similar to Western samples. There are, however, differences from past research, as sensitivity to reward did not predict drinks per occasion in either genotype. This could be due to sociocultural, "group first" pressures that are said to exist in East Asian cultures (Becker, 1986; Nisbett, 2003; Yun & Park, 2008), which might drive those South Korean drinkers who would prefer to drink less, to drink at higher levels. Therefore, comparing just the ALDH2 (1/1) group to Western samples, which takes differences in the buildup of acetaldehyde out of consideration, there appears to be a difference in the personality trait/drinker type relationships between the current wild (1/1) genotype and data from western samples (Kambouropoulos & Staiger, 2001; O'Connor & Colder, 2005; Simon & Arens, 2007). This further implies that cultural variables may differentiate the current South Korean sample from the Western samples.

It is important to note that there are only small differences in overall alcohol consumption between the ALDH2 genotypes. It seems that a combination of positive (higher tension reduction for ALDH2 (2/2) heavy drinkers) and negative (the consequences of acetaldehyde) influences act as incentives for the ALDH2 (2/1) to drink large amounts by the tension reduction effect, but perhaps, paradoxically, protect them from lifetime alcohol dependency by the negative effects of the buildup of ACD. Sociocultural differences that exist in East Asian countries (Becker, 1986; Nisbett, 2003; Yun & Park, 2008) might also mitigate the negative effects of alcohol. Given that it is considered impolite to refuse directions given by elders (Yun & Park, 2008), drinking on despite the negative physiological effects might be passed from one generation to the next. Thus, the importance of the group might also help explain the relatively high level of alcohol consumption in South Korea, particularly among males, as alcohol has become part South Korean male culture.

4.1. Future research

Those wishing to further explore alcohol expectancy in East Asian populations may be interested in the finding that heavy drinkers with ALDH2 (2/1) are reporting lower levels of *arousal* expectancy, which is the opposite of what is reported by western samples (Rather, Goldman, Roehrich, & Brannick, 1992; Reich, Noll, & Goldman, 2005). Furthermore, sensitivity to reward appears to have less of an impact on the drinking levels of South Korean heavy drinkers compared to Western populations, as research using Western populations has shown that SR is a good predictor of heavy drinking (O'Connor & Colder, 2005). This is important, as research suggests that those high in SR more readily respond, implicitly, to alcohol-related stimuli (Carver & White, 1994; Kambouropoulos & Staiger, 2001). How these factors, coupled with the higher level of negative expectancy, affects the implicit attentional bias for alcohol-related stimuli seen in past research using Western populations may be of interest to future research.

5. Conclusion

Overall, the current results shed some light on why South Korea, despite the prevalence of ALDH2*2 mutations, maintains high levels of alcohol consumption, with both biological and cultural influences likely having an effect. The results suggest that those with the ALDH2 (2/1) gene need to be less sensitive to punishment if they are to maintain high levels of alcohol consumption, at which point they appear to be rewarded with a tension reduction effect. In contrast those with the ALDH2 (1/1) gene drink due to expectations regarding its general positively reinforcing qualities.

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