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Development and validation of the Sports Supplements Beliefs Scale

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ABSTRACT

It has been proposed that the use of sports supplements by athletes might lead to the use of banned substances. This has been termed the gateway hypothesis. Given this hypothesis, if we accept that athletes use non-banned sports supplements because they believe that they will be effective, a measure of athletes' beliefs about supplements might allow practitioners to identify athletes at risk of doping. We report the five-stage development of the Sports Supplements Beliefs Scale (SSBS). In study 1 we evaluated athletes' beliefs about sports supplements by conducting semi-structured interviews on 16 athletes. Inductive and deductive analyses resulted in a pool of 26 items. In study 2 we recruited a panel of experts and athletes to evaluate the content validity of the 26 items. 15 items were eliminated at this stage. In study 3 we subjected the responses of 171 athletes to exploratory factor analysis to determine the factor structure of the scale. A two-factor model emerged, with one strong six-item factor, a less coherent four-item factor, and one item that cross loaded. In study 4, responses of a sample of 412 team sports athletes were subjected to confirmatory factor analysis. Of three competing models tested, a six-item single-factor model demonstrated best model fit ($\chi^2/df = 2.894$, RMSEA = 0.068; 90% CI = 0.038 to 0.099, $p > 0.146$, SRMR = 0.0246, CFI = 0.987, TLI = 0.978, AIC = 50.045, EVCI = 0.122). Factor loadings ranged from 0.4 and 0.9. All *t*-values were statistically significant ($p < 0.001$) and ranged from 10.3 to 13.3. In study 5 we examined relationships between scores on the six-item scale and supplement use. Linear regression indicated that higher scores were significantly associated with the use of a greater number of supplements ($\beta = 0.534$, $p < 0.001$, $r^2 = 0.285$) and higher frequency of supplement use ($\beta = -0.517$, $p < 0.001$, $r^2 = 0.267$). Scores of users and non-users of supplements differed significantly (mean differences = 6.37 ± 0.56, $U = 8$, $p < 0.001$), with discriminant function analysis indicating that scores correctly predicted 76% of sport supplement users and 66% of non-users (Wilks Lambda = 0.760 $\chi^2 = 110.988$, $p < 0.001$). Whilst future research will be required to demonstrate its predictive validity, the SSBS has utility in the assessment of athletes' beliefs about sports supplements. In the context of the gateway hypothesis, SSBS scores might play a meaningful role in identifying at risk athletes and in evaluating interventions.

1. Introduction

Doping, the use of banned substances by athletes, undermines the ethos of sport and can place the health of athletes at risk. To deter doping, national anti-doping agencies devote substantial resources to detecting and punishing athletes who are using banned substances, with up to 250,000 tests conducted annually (Pound, Ayotte, Parkinson, Pengilly, & Ryan, 2013). However, analytical findings of drug tests have remained the same for the past 10 years, with only ~1–2% of tests showing a positive result. The World Anti-Doping Agency has thus endorsed a preventative approach (World Anti-Doping Agency, 2015) with many researchers seeking to identify the psychological risk factors for doping (see Ntoumanis, Ng, Barkoukis, & Backhouse, 2014 for review) that might inform policy.

In relation to the last point above, it has been proposed that the use of non-banned sport supplements such as caffeine, creatine and sodium bicarbonate, might be a risk factor for doping. In short, the use of non-banned substances can lead to the use of banned substances. In a recent meta- analysis (Ntoumanis et al., 2014), the strongest correlate of doping behaviour was the use of sport supplements. Sports supplements are widely used by athletes of all ages and abilities (Knapik et al., 2016), with the aim of enhancing performance, recovery, and/or other sport related factors (Nieper, 2005 Maughan, King, & Lea, 2004; Lun, Erdman, Fung, & Reimer, 2012).

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The idea that use of non-banned and arguably safe substances by athletes might lead to the use of banned and potentially unsafe ones is provocative. However, several hypotheses might explain this association. Thorndike's (1911) 'law of effect,' suggests that the probability of a response being made is increased when followed by a reward and decreased when followed by discomfort. An athlete using a sport supplement for the first time is likely to attribute any potential improvements (or decrements) in performance to the supplement, with improvements in the athlete's performance suggested to increase the likelihood of future supplement use and decrements suggested to decrease this. Further positive experiences of supplementation reinforce the belief that the supplement is effective, and negative experiences reinforce the belief that the supplement is ineffective. The response to the supplement is thus reinforced by the outcome in performance. This is underpinned by Pavlovian conditioning, where a stimulus (i.e. sport supplement) is associated with a response (i.e. improvement in performance), which can reinforce the substances effectiveness (Everitt & Robbins, 2013). These experiences can create cues that embody affective states and strengthen the association between the response and the stimuli (Stewart, De Wit, & Eikelboom, 1984). The conditioned effects of a substance can activate neural mechanisms that mimic the neural activity of the substance, and it is the activation of these states by conditioned stimuli that initiates further substance use behaviour (Everitt & Robbins, 2005, 2013). However, with repeated exposure of a substance, the pharmacological effects are often markedly reduced over time and the brain systems that are normally involved become desensitised to the physiological effects, but more significantly, become hypersensitive to the associated stimuli (Hyman & Malenka, 2001). Sensitisation of substances may lead to an increased use of the same substance or use of another, stronger, substance; a process termed 'cross-sensitisation' (Robinson & Berridge, 1993).

Whilst it is clear that numerous hypotheses might explain the progression to strong drugs through the use of weaker ones, the term 'gateway hypothesis' has been used as a coverall. Originally credited to Kandel (1975), the gateway hypothesis proposes that individuals become increasingly involved in drugs in stages and in sequences. Kandel (1975) reported that if adolescents progress to marijuana use, the likelihood of using harder illicit drugs, such as cocaine and heroin, would significantly increase from 2 and 3% to between 16 and 23%. More recent epidemiological data report that 56.3% and 84.5% of high school students would smoke tobacco or drink alcohol before progressing to marijuana and cocaine respectively (Johnston, O'Malley, Miech, Bachman, & Schulenberg, 2013). Further evidence from the Substance Abuse and Mental Health Services Administration (2013) revealed that 65% of marijuana users started smoking or drinking before they started using marijuana, whilst 97% of cocaine users started smoking or drinking before progressing to cocaine. Fergusson and Horwood (2000) reported that over 99% of illicit drug users in New Zealand would use cannabis first before progressing to other illicit drugs and Prince van Leeuwen et al. (2014) reported that tobacco use in the Netherlands was associated with a higher likelihood of developing a marijuana use disorder.

Although the above epidemiological evidence has arguably established a weak drug-strong drug sequence in which different substances are used, it has not identified what causes the progression from one drug to the next. For this reason, many authors have criticised the validity of the gateway hypothesis and its causal mechanisms (Kleinig, 2015; Vanyukov et al., 2012). However, animal studies have shown that the intake of a 'softer' drug can increase the intake of a 'harder' drug; for example animals sensitised to amphetamines have shown an increased intake of cocaine (Ferrario & Robinson, 2007), whilst animals given access to sugar increase the intake of alcohol (Avena, Carrillo, Needham, Leibowtiz, & Hoebel, 2004) and cross-sensitise to cocaine (Gosnell, 2005). Levine et al. (2011) proposed a molecular explanation for the gateway hypothesis and the sequence of drug use, suggesting that exposure to nicotine causes specific changes in the brain that make it more vulnerable to cocaine addiction. It was also shown that pretreatment with nicotine greatly alters the response to cocaine in terms of addicted related behaviour and changes in brain regions critical for addiction related rewards. Furthermore, and at a molecular level, nicotine enhanced the effect of cocaine when it was administered for several days prior to the use of cocaine. These results stimulated further analysis of epidemiology data, where Kandel and Kandel (2014) reported cocaine users would often start using cocaine only after prolonged smoking of tobacco. Collectively, data suggest that in the general population in Western societies, there is a well-defined sequence of progression of drug use. That is illicit drug use often starts with a softer drug and proceeds to harder drug use. The idea of the gateway hypothesis has influenced US drug policy since the 1950′s (Morral, McCaffrey, & Paddock, 2002).

Whilst the sport-specific database is less well developed than the substance use literature, it is proposed that in a manner similar to that in which the use of legal recreational drugs (e.g., alcohol and nicotine) leads progressively to the use of stronger illegal drugs in the general population, the use of sport supplements by athletes might lead to the use of stronger and often banned substances (Lentillon-Kaestner & Carstairs, 2010; Hildebrandt, Harty, & Langenbucher, 2012).

The available research in sport is based on the testimony of athletes, and not on experimental or epidemiological data. Furthermore those testimonies are in relation to a contentious subject, so cannot be described as entirely unproblematic (for example, it is as plausible that athletes who dope use supplements to optimise drug effects as it is that athletes who use supplements go on to dope). It must also be made clear that as is the case with progression from alcohol and marijuana, for example, progression from sport supplements to doping substances is far from inevitable. However, given both the physiological and epidemiological evidence above, and given that there is no reason to suggest that sport represents a special case in relation to substance use, the gateway hypothesis represents a plausible mechanism and warrants further investigation.

As suggested above, anti-doping agencies seek methods to identify athletes more susceptible to doping. Although still a developing field, the main focus of this work has been involved with the development and validation of psychometric measures that sufficiently identify and quantify psychological constructs of doping behaviours (Petróczi et al., 2015). However, obtaining reliable self-report information about *explicit* doping behaviours is associated with several ethical and practical challenges, including the considerable problem that an admission of use of a banned substance can result in the athlete losing their right to participate in sport. For this reason, researchers generally use one or more psychological constructs as a proxy to doping behaviour. To date, the validated psychological methods used have mainly focused on quantifying athletes' attitudes towards doping (e.g. Petróczi and Aidman, 2009; Brand, Melzer, & Hagemann, 2011). Athletes reporting more favourable attitudes towards banned substances are predicted to be more likely to initiate the behaviour. Other cognitive variables, for example moral disengagement, sport orientation and task and ego orientation, have also been used to describe an athletes doping mindset (Petróczi et al., 2015).

Recent data suggest that athletes who use sport supplements tend to express more favourable beliefs about the effectiveness of these types of substances compared to non-users (Backhouse, Whitaker, & Petróczi, 2013). Furthermore, athletes' beliefs about sport supplements influence future behaviours and intentions (Bell, Dorsch, McCreary, & Hovey, 2004). Hypothetically therefore, if ath-

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