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**Special issue in Current Neuropharmacology entitled “NPS, a novel global issue; neuropharmacological, chemical and toxicological aspects”**

**Evolutionary considerations on the emerging subculture of the e-psychnauts and the novel psychoactive substances: a comeback to the shamanism?**

Laura Orsolini<sup>1,2,3\*</sup>, Paul St John-Smith<sup>4</sup>, Daniel McQueen<sup>5</sup>, Duccio Papanti<sup>1</sup>, John Corkery<sup>1</sup>, and Fabrizio Schifano<sup>1</sup>

**Affiliations**

<sup>1</sup> Psychopharmacology, Drug Misuse and Novel Psychoactive Substances Research Unit, School of Life and Medical Sciences, College Lane Campus, University of Hertfordshire, Hatfield, Herts, AL10 9AB, UK. Tel: +44 (0) 1707-286107; Fax: +44 (0) 1707-284506.

<sup>2</sup> Villa San Giuseppe Hospital, Hermanas Hospitalarias, Ascoli Piceno, Italy.

<sup>3</sup> Polyedra Research, Polyedra, Teramo, Italy.

<sup>4</sup> Hertfordshire Partnership University NHS Foundation Trust, Civic Offices, Elstree Way, Borehamwood, Hertfordshire, WD6 1WA, UK. Tel: +44 (0) 1707-286107; Fax: +44 (0) 1707-284506; email: [paul.stjohnsmith@hpft.nhs.uk](mailto:paul.stjohnsmith@hpft.nhs.uk).

<sup>5</sup> Child and Family Department, The Tavistock and Portman NHS Foundation Trust, Child and Family Department – 120 Belsize Lane, London, NW3 5BA & Eating Disorder Unit, Cygnet Hospital Ealing, 22 Corfton Road, Ealing, W5 2HT. Tel: (+44) 0208 991 6699; Fax: 0208 991 0440; email: [daniel.mcqueen@nhs.net](mailto:daniel.mcqueen@nhs.net).

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\* Corresponding author: Dr. Laura Orsolini, Psychopharmacology, Drug Misuse and Novel Psychoactive Substances Research Unit, School of Life and Medical Sciences, College Lane Campus, University of Hertfordshire, Hatfield, Herts, AL10 9AB, UK. Tel: (+44) 0208 731 3003; fax: +44 (0) 1707-284506. E-mail: [laura.orsolini01@gmail.com](mailto:laura.orsolini01@gmail.com).

## **ABSTRACT**

*Background:* Evolutionary research on drug abuse has hitherto been restricted to proximate studies, considering aetiology, mechanism, and ontogeny. However, in order to explain the recent emergence of a new behavioural pattern (e.g. ‘the e-psychonaut style’) of novel psychoactive substances’ (NPS) intake, a complementary evolutionary model may be needed.

*Objective:* A range of evolutionary interpretations on the ‘psychonaut style’ and the recent emergence of NPS was here considered

*Method:* The PubMed database was searched in order to elicit evolutionary theory-based documents commenting on NPS/NPS users/e-psychonauts.

*Results:* The traditional ‘shamanic style’ use of entheogens/plant-derived compounds may present with a range of similarities with the ‘e-psychonauts’ use of mostly of hallucinogen/psychedelic NPS. These users consider themselves as ‘new/technological’ shamans.

*Conclusion:* Indeed, a range of evolutionary mechanisms, such as: optimal foraging; costly signalling; and reproduction at the expense of health; may all cooperate to explain the recent spread and diffusion of the NPS market, and this may represent a reason of concern.

**Keywords:** evolutionary models; dual inheritance models; emotions; novel psychoactive substances; NPS; entheogens; psychonauts; shamanism; evolution; psychiatry; adeptness; costly signalling; handicap principle; fitness.

## 1. Introduction

In order to fully understand and adequately explain any behaviour, including drug initiation/abuse, a range of issues, that may be schematically ranked in *proximate* (e.g. causation/mechanisms; and ontogeny/developmental trajectory) and *ultimate/evolutionary* (e.g. survival value/biological fitness and evolutionary/phylogenetic history), should be considered [1-2].

Nowadays, there are many different classes of substances available for abuse, including several hundreds of novel psychoactive substances (NPS) [3-6]. Some of these drugs are entirely synthetic whilst others either occur naturally in plants, or are chemically modified from plant compounds [3-5]. It has been well documented the history of the co-evolution of humans with some plant toxins [7-9], mainly due to their antiparasitic/antibacterial properties [10-11]. Humans have learnt how to cultivate, modify and take advantage of these chemicals and, according to the ‘*Dual Inheritance*’ theory [12-13], have passed on this cultural knowledge to others [14-20]. These plant molecules have been ingested by humans over millennia for their advantageous evolutionary benefits as well as for their ritual/healing effects amongst shamanic cultures [19]. Hence, one would argue that the use of a range of these natural substances, from which the NPS are mainly derived, has a long evolutionary history [14-16, 18-20].

Evolutionary concepts open new perspectives on why and how these natural plant substances were identified, cultivated and exploited by our ancestors, but may also help explaining the recent spread of NPS market and the appearance of a new subculture of NPS enthusiasts/drug users, the so-called e-psychnauts [21]. Indeed, psychnauts define themselves as ‘shamans’, whilst showing psychological features and motivations different from those displayed by traditional drug users. At the same time,

the recent increasing levels of NPS ingestion worldwide [5-6] may represent an evolutionary challenge for our systems of adaptation, e.g. a proper ‘mismatch’ in terms of ability of our body to detoxify from these new compounds, arguably resulting in detrimental effects [17].

In considering the above, we aimed here at providing an overview of a range of evolutionary interpretations of both drug/NPS initiation and misuse and the ‘psychonaut style’ [21].

## 2. Methods/Literature Search Strategy

A literature search on PubMed was conducted using the following sets of keywords: (*designer drugs OR Novel Psychoactive Substances OR NPS OR shamanism OR shaman OR psychonaut OR drug use OR drug abuse*) AND (*evolution OR evolutionary psychiatry OR Darwinian psychiatry OR Darwinian medicine OR evolutionary medicine*). No language or time restrictions were placed on the electronic search, covering the period up to March 2016. No filters were applied to limit the retrieval process, although the primary focus was here on human studies. Articles of relevance were used as sources of further papers via references. Personal archives of reference, including textbooks, by leading experts in the field were further identified and analysed. The search was performed independently by LO and PStJS, with kappa levels of agreement being 0.8. data were compared and discrepancies were settled, if needed, with the supervision of FS. With the initial set of keywords, some 38,544 studies were identified. Of these, 15,454 were excluded because focusing on preclinical/animal research whilst 17,759 did not meet the inclusion criteria. Out of remaining 5,331 studies, 5,230 were excluded because not consistent with the aims of the present study, leaving a total of 101 documents to be considered in this review.

### **3. Drug initiation and misuse; evolutionary and ethological perspectives**

A number of evolutionary concepts relating to the vulnerability to drug initiation and persistence of misuse were here selected, including: the ‘mismatch’ theory; tradeoffs; protective behaviour, defences and emotions; pharmacophagy and related infection control; reproduction at the expense of health; the costly signalling behaviour; the handicap hypotheses; the optimal foraging theory; the cultural reputation; and the influence of religion/spirituality on drug ingestion [9, 12-13, 17, 22-55].

**3.1. the *Mismatch theory*** is based on the idea that humans possess traits/behavioural patterns that have been selected for, and preserved by, the natural selection process because of their adaptive function in a specific environment (e.g. the Environment of Evolutionary Adaptation; EEA), which was unlike the current one [30]. Hence, our ‘ancient’ adaptive traits may be largely ‘mistuned/mismatched’ to the current environment. These mismatch levels may be further enhanced by the constant/rapid/relentless engineering of previously unknown NPS [3-6], whose availability may strongly hinder the adaptation of humans’ biological systems.

**3.2. *Tradeoffs*.** Selected traits and related adaptations often had to involve tradeoffs or compromises. For example, when males advertise for mates, they often produce some signals which are meant to affect the females’ choice [56]. Females often prefer those signals indicating that the candidate male partner may provide high fitness alleles and/or material resources to females/offsprings [35, 49, 57]. From this point of view, the risky/costly/tradeoff use of plants/drugs, including the most recent NPS, may be exploited by some individuals since this may confer some evolutionary advantage in a specific environment.

**3.3. *Protective behaviour, defences and emotions*.** Both survival and reproductive success (Darwinian fitness) are unsurprisingly rewarded through positive emotions (e.g.

happiness, pleasure, excitement) [58]. Conversely, behaviours that are likely to overall decrease fitness levels produce aversive or negative emotions (e.g. pain, depression, anxiety, and fatigue). Many misusing substances usually hijack or override the brain's natural reward and punishment centres [22-23, 27-28, 33, 36, 39, 52], with the largely pleasurable effects of these drugs often leading the user to feel that drug intake confers fitness advantages [48]. Furthermore, drug intake may represent a protective defence against an unpleasant/hostile environment. For example, stimulant ingestion may help in obtaining/maintaining adequate levels of performance, energy and working ability.

**3.4. *Pharmacophagy and infection control.*** Many psychotropic substances present with bactericidal and/or antiparasitic effects, hence assisting in infection prevention/elimination [9]. In both human and non-human species [11, 41, 59-60], these antiparasitic effects may have originally been an unintentional by-product of diet/herbs' intake, with eventual selection/related adaptation for a taste of these compounds [41, 61-62].

**3.5. *Increasing reproductive fitness; reproduction at the expense of health:*** Although counterintuitive, a trait that significantly increases reproduction will tend to spread, even if it harms the health of individual. In the EEA environment, investments in competitive ability/risky behaviours were sexually selected by males in order to achieve greater reproductive payoffs [37, 43-44, 47]. These considerations may also explain early drug use 'to show off', e.g. impress potential sexual partners.

**3.6. *Costly signalling theory*** explains the evolutionary value of apparently wasteful behaviour (i.e. altruism) involving some levels of 'sacrifice' [24, 38]. High quality signallers are more successful in acquiring mates or allies, with signals being either 'honest', indicating superior biological value, or 'false' (e.g. implicating cheating), when they mislead about the real underlying biological value of the signaller. Shamans' psychoactive plants' ingestion was considered by the tribe components as a proper risky behaviour 'per se', hence perceived as

both altruistic and honest [63-64]. Similarly, the psychonautic behaviour, e.g. the decision to ingest a range of substances whilst sharing the on-drug subjective effects with the community, is considered a shaman-like/altruistic behaviour [65].

**3.7. *Handicap principle*** [32]: Disadvantaged, drug using, males who can still demonstrate superiority, such as winning a fight, may in this way demonstrate their strength, fitness and bravery to potential mates. Therefore, even though a handicap/high-risk strategy, early drug use may signal bravery and thereby increase the chance of reproduction within a range of specific environments. Indeed, early drug taking may be associated with precocious sexual activity and teenage pregnancy [66-69].

**3.8. *Optimal foraging theory*** [26, 34, 45]: under conditions of scarcity/low prospect of future success, a strategy of caution will lead to death, whilst a short-term/high-risk strategy may lead to survival. From this perspective, for people who feel that they have ‘little to lose’, it may be an adaptive strategy to engage in greater risk taking behaviour/activities. Disinhibition due to substance use can lead to easier mating encounters, hence increasing the chances of reproducing [70-71].

**3.9. *Cultural reputation*** [30]: Naming, branding and packaging are some of the ways in which the ‘cultural reputation’/meaning of different drugs is manipulated to influence consumers [72]. The ‘reputation’ of NPS is clearly amplified by their virtual dissemination through the internet and social networks [21, 73].

**3.10. *Religion, spirituality and ancient rituals’ ceremonies.*** Religion and spirituality appear to have co-evolved with a larger hominid brain capable of consciousness and a sense of agency [25, 29, 31, 74-75]. In order to demonstrate loyalty to the group, religious rituals are typically carried out in public, involve costly/elaborated ceremonies and customs, hence are associated with large placebo effects [53-54]. Although plant/drug intoxication rituals appear counterintuitive and paradoxical in evolutionary fitness terms [46, 51], sharing the

related spiritual experiences may confer advantages by increasing group cohesion [42, 76-82].

#### **4. Shamanism and the entheogen/psychedelic use in shamanic practices**

Shamans [83] are often selected for having visions or signs from gods whilst going through trance states through a variety of procedures, which typically include hallucinogen/entheogen intake [64]. Religious/shamanic rituals are universally observed in all cultures, hence suggesting an evolutionary origin/survival value [84-88], with mild forms of schizophrenia possibly having enhanced shaman's ability [89-91].

Entheogens (etymologically, '*that which causes God to be within an individual*') are typically psychedelics/hallucinogens [92] which generate transcendental feelings and/or hallucinatory experiences being traditionally interpreted as spirit visitations [93]. A variety of hallucinogenic mushrooms and plants, such as psilocybin mushrooms, Ayahuasca, peyote, cannabis, *Salvia divinorum* have been/are being used in rituals by shamans throughout the world [93-97]. Interestingly, club drugs (e.g. ecstasy and ketamine) have been associated in dance/party settings with a spiritual awakening of self-awareness; sense of liberation [98], and mystical experiences [99].

#### **5. Novel psychoactive substances**

NPS are usually synthetic molecules that may have effects and active constituents similar to plant drugs [3-5]. The short time-frame from NPS synthesis to ingestion/exploitation means natural evolution of tolerance or resistance to them cannot possibly have taken place ('mismatch theory'). Many NPS are so new they cannot have been formally tested in animals yet, putting indeed drug users at risk [3-6].

In line with what suggested here in commenting about both the ‘cultural reputation’ and ‘dual inheritance’ theories, the use and sales of NPS for psychotropic purposes may well depend on cultural factors such as fashion, attractive naming, labelling, and the online ‘word of mouth’ knowledge [5, 73]. Overall, according to the ‘reproduction at the expense of health’ theory, and despite the NPS consumption being a risky strategy, for each macro-family of NPS [5] a specific evolutionary/adaptive correlate could be identified:

*-Psychostimulant/amphetamine-like drugs* (e.g. novel stimulants such as 4,4-DMAR, methiopropamine, modafinil; ethylphenydate; synthetic cathinones; synthetic cocaine substitutes; MDMA-like drugs; piperazines): main related adaptive advantages may be represented by: improved control on the natural environment by increased perceptual skills, time reaction to stimuli and resistance to stressors; decreased feelings of fatigue/sleep; and improvement of competitive strategies/academic performances.

*-Sedatives/anxiolytics/hypnotics* (e.g. novel designer benzodiazepines; synthetic opioids, GHB, etc): main adaptive advantages may be represented here by an increased control of anxiety/fear hence better coping strategies during life stressor events; an increased sexual disinhibition/availability for mating; and a better control of painful stimuli.

*-Entheogens/hallucinogens/dissociatives* (e.g. synthetic cannabinoids/’Spice’ drugs; latest generation psychedelic phenethylamines such as NBOMe drugs; novel tryptamines derivatives.; phencyclidine/ketamine-like dissociative drugs; herbal highs such as *Salvia divinorum*, *Myragina speciose*/’Kratom’ etc.): main adaptive advantages may be represented here by increased empathy levels, hence better establishment/strengthening of attachment bonds in a given environment; and improvement of own social status within specific environments.

## **6. Psychonauts and e-psychonauts: self-appointed shamans?**

The cultural reputation and attraction for NPS mainly derives from their use among the new drug users' generation, the so-called psychonauts [100]. From an evolutionary point of view, psychonauts' drug intake presents with similarities with the ancient shamanic ritual plant consumption. Indeed, psychonauts' drug preference mainly refers to NPS with entheogen/hallucinogenic properties [21].

The term 'psychonaut' was first introduced by Jünger [101] who described individuals who took psychoactive drugs with the stated intention of achieving greater knowledge of what he called the 'inner universe', whilst possibly addressing spiritual questions. Carroll [102] underlined the experimental use of drugs as appropriate tools to reach the state of 'psychonaut' (*'a sailor of the mind/soul'*). For these reasons, some consider psychonauts to be similar to traditional shamans [65]; 'new/virtual shamans' [21]; 'chaos magickians' [103]; 'techno-shamans' [104-106]. Conversely, the term 'e-psychonaut' refer to 'psychonauts living in the information age'. Typically, these 'psychedelic researchers' or 'alchemists' [107-109] are quite knowledgeable about pharmaceutical and chemical properties of drugs, having experiment with a range of psychoactives and typically reporting their experiences online to peers/other 'psychonauts' [105-106].

Similar to shamans, the e-psychonauts may be conceived as a sub-cultural group which presents with its own specific 'initiation rites', e.g. the practices required by the communities to the novel psychonaut applicant. These requirements include the need to formally enlist to the chosen forum, so that both the applicant contribution/posts/entries, but also the threads proactively s/he follows overtime, can be properly scrutinized. During the eventual 'trial phase', the applicant will need to post a given number of 'trip reports' relating to a range of plant-derived substances/entheogens (*'...you cannot be a psychonaut without tripping on drugs that helps in exploring the mind'*)[105]. The applicant will possess excellent language/descriptive skills, so that his/her on-drug/trip reports can be made available in an

accurate and precise way [110]. Once recognized as an ‘approved psychonaut’, the applicant will be able to access a range of areas within the forum whose access was previously denied. In association with this, the successful applicant will be provided with a range of codes which will allow him/her the access to a range of sites providing a vast range of NPS purchase opportunities and located on the darknet/deep web [73].

Similar to shamans, e-psychonauts’ main beliefs and goals have more often to do with the achievement of altered states of consciousness rather than with recreational purposes [105, 109]. Furthermore, the extensive level of web sharing activities facilitates the spread and selection of the ‘psychonaut cultural phenotype’ [105]. Cooperation, sharing and coordination with others are associated with evolutionary benefits [111]. Within the psychonauts’ communities, the intake of psychedelics is considered the *trait d’union* of e-psychonauts, a ritual form of bonding which facilitates as well the psychedelic information flow [112]. Consistent with these observations, there is some evidence that psychedelic drug users report greater concern for others compared to both other drugs’ users and drug naïve subjects [99, 113-114]. In social interactions, approval and disapproval are most typically signalled by facial expressions [115-117]. Conversely, e-psychonauts rely on their written linguistic skills only for sharing the drug intake experiences [21].

## **7. Discussion**

The evolutionary perspective here considered may shed further light on some of the underlying mechanisms of drug initiation and abuse; neo-shamanism; and NPS use. The observation that psychotropic drugs act on evolutionarily preserved motivational systems is consistent with the fact that, similar to humans, a range of mammals demonstrate compulsive self-administration of these same molecules/plants/herbs [39, 118]. Analyses of humans’ ancestral diets reveal wide use of psychoactive plant chemicals by early hominids, possibly

conferring alertness, overcoming exhaustion, and appetite suppression, whilst presenting with bactericidal and anti-parasitic properties [55].

Nowadays, the fervent NPS market opens up new perspectives on self-experimentation and self-medication. However, there is a mismatch between the availability and strength of these new compounds and the mechanisms that humans have developed to cope with them, only resulting in extremely detrimental disadvantages in terms of survival and health. Conversely, since drug/NPS ingestion is a risky behaviour, hence an ‘honest signal’ indicating bravery or vigour, this may somehow increase the drug user’s sexual attraction. When prospects of success are very low, high-risk strategies confer at least the possibility of success, and may be adaptive [119]. Furthermore, in some cultural sub-groups, as here discussed, hallucinogenic/dissociative NPS would arguably confer adaptive advantages in terms of improved social status.

Further studies should be carried out to better understand the cultural/evolutionary background of the current increasing levels of NPS misuse.

### **Conflicts of interest**

FS is both a Core Member of the Advisory Council on the Misuse of Drugs (ACMD, UK) and the Chair of the Specialist Advisory Group (Psychiatry) for the European Medicines Agency (EMA). No conflicts of interest are declared here that may have influenced the interpretation of the present data.

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