

**Revista de
Neuro - Psiquiatría**

Revista de Neuro-Psiquiatría

ISSN: 0034-8597

revista.neuro.psiquiatria@oficinas-
upch.pe

Universidad Peruana Cayetano Heredia
Perú

Giuffra, Luis A.

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Revista de Neuro-Psiquiatría, vol. 78, núm. 1, 2015, pp. 30-34

Universidad Peruana Cayetano Heredia

Lima, Perú

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A proposed mechanism of action for the Twelve steps of Alcoholics Anonymous.

Un mecanismo de acción propuesto para los Doce pasos de Alcohólicos Anónimos .

Luis A. Giuffra ^{1, a, b, c.}

RESUMEN

Entre los grupos de apoyo mutuo a alcohólicos, Alcohólicos Anónimos (AA) es, sin duda, el más exitoso de todos, con decenas de miles de grupos dispersos por el mundo. Sin embargo, el mecanismo de acción de AA no está claro. Los avances en la neurociencia de la adicción han permitido identificar dos áreas cerebrales que, entre otras, explican el comportamiento irracional y autodestructivo de los alcohólicos. Por un lado, el alcohol “secuestra” los centros del cerebro encargados de detectar y sentir placer, y le proveen (a través de la liberación de dopamina en el núcleo accumbens y el área ventro-tegmental) con un estímulo placentero mucho mayor al de las experiencias típicas que nos producen placer (tales como alimentarnos y reproducirnos), siendo experiencias esenciales para la supervivencia y la evolución de las especies. La reproducción y evolución de las especies solo es posible por la forma en que el placer está íntimamente ligado a la supervivencia y reproducción del individuo, y es esta asociación la que es usurpada por las sustancias como el alcohol. Por lo tanto, para los centros del placer el alcohol equivale a la supervivencia del alcohólico. Por otro lado, el área de la corteza prefrontal (quizás el único lugar del cerebro que nos permite entender y prevenir los peligros del uso excesivo y compulsivo del alcohol) es también afectada por esta sustancia, que la convierte en hipoactiva e incapaz de contrarrestar las demandas del centro del placer de repetir la experiencia placentera (que ha resultado en la supervivencia del individuo y la evolución de las especies) asociada a usar alcohol. Los doce pasos de AA ayudan al alcohólico a revertir estos efectos, a través del uso de un sustituto en la toma de decisiones (el sustituto es, con frecuencia, los miembros de AA) y a través de conductas compensatorias dedicadas a revertir las conductas destructivas que facilitan al alcohólico el poder continuar intoxicándose. El mentir, robar, no ser honesto y ser manipulador no son síntomas de un trastorno de personalidad del alcohólico: son los síntomas de un centro del placer secuestrado por el alcohol y de una corteza prefrontal hipoactiva.

PALABRAS CLAVE: alcoholismo, alcohólicos anónimos, adicción.

SUMMARY

Among peer-support groups for alcoholics, Alcoholics anonymous (AA) is by far the most widespread and successful with tens of thousands of groups all around the world. However, the mechanism of action of AA's success is not immediately clear. Advances in understanding the neuroscience of addiction have allowed the identification of two brain areas that, among others, explain the irrational and self-destructive behavior of alcoholics. First, alcohol hijacks the reward systems of the midbrain in charge of detecting and experiencing pleasure (through the release of dopamine in the nucleus accumbens and the ventral tegmental area) with a pleasurable stimulation that far exceeds the normal pleasures of life (such as eating and sexual reproduction). These pleasurable experiences are essential for the survival and evolution of the species. Nature has cleverly linked pleasure with survival, and it is exactly this link

¹ Washington University. St Louis, USA.

^a Professor of Clinical Psychiatry.

^b Medical Doctor.

^c Philosophiæ doctor

that is usurped and hijacked by intoxicants like alcohol. Therefore, the reward system senses the effect of alcohol as essential for the survival of the alcoholic. In addition, the prefrontal cortex (perhaps the only area of the brain that could allow us to understand and prevent the dangers of the excessive and compulsive alcohol use) is also affected by this intoxicant. It becomes hypoactive and unable to counteract the urges and demands of the reward system to constantly repeat the “feel good” (associated over millions of years with survival of the individual and species) that comes from using alcohol. The Twelve Steps of AA help alcoholics reverse these effects. First, through steps 1 to 3, it encourages the use of a Surrogate Decision-Maker (often, it is the AA group itself that acts as such). Second, steps 4- 12 foster the practice of Compensatory Behaviors (a life of honesty and service) devoted to counteract the maladaptive behaviors that facilitate the alcoholic’s behavior of repeating what feels good (i.e. getting intoxicated). Lying, stealing, dishonesty and manipulation are not intrinsic personality defects of the alcoholic: they are the symptoms of a usurped reward system and hijacked prefrontal lobes.

KEYWORDS: Alcoholism, alcoholics anonymous, addiction.

Alcoholics have been gathering in self-help groups trying to achieve sobriety for over 200 years. The Temperance Movement dates back to the 1780s. The Total Abstinence Society was founded in the 1830s. The following decade, The Washingtonian movement was established, followed by the Women’s Christian Temperance Union in the 1870s and the Anti-Saloon League in the 1890s. All these groups relied on some form of self-support and promoted full abstinence from alcohol. None survived the passage of time. However, since 1935, the most successful self-help group in the history of alcohol treatment, Alcoholic Anonymous, (AA) continues to thrive and expand. AA is, without a doubt, the largest (over 2 million members) and most widely available (over 150 countries) of all self-help groups. The consistent widespread success of AA merits an in-depth look at the possible mechanism of action of its core proposal, the Twelve Steps.

Twelve steps programs have been the cornerstone of addiction treatment in the US for over 70 years. A program started by two desperate alcoholics in 1935 (Bill Wilson and Bob Smith, known among AA members as Bill W. and Dr. Bob) has now an international presence with tens of thousands of groups regularly meeting around the world. It has been criticized and misunderstood, yet voices against AA have failed to slow down its progress and success. Unlike other therapies in medicine, the mechanism of action of AA’s Twelve Steps remains obscure. Patients can easily understand why an antibiotic is needed to treat an infection, or why surgery is needed to remove a tumor. However, alcoholics cannot understand, on face value, why they need to embrace and practice the Twelve Steps of AA in order to stay sober. This represents an obstacle for prospective members since it is not intuitive or straightforward to understand why following the steps can help maintain sobriety. We can

easily understand why an antibiotic works when we treat bacterial pneumonia or why radiation therapy treats cancer. In the case of the Steps, however, there is no coherence between our understanding of how addiction affects the brain and why the Steps could help.

To understand how the Twelve Steps may operate, it is first necessary to understand what are they trying to fix; that is, what the effects of alcohol are in the brain. Knowing what alcohol does to the brain makes it easier to understand how the Steps might counteract these effects.

Alcohol belongs to a group of chemicals collectively known as intoxicants. Members of this group are able to generate abuse and dependence among users. There are about 30 million chemical compounds known to man, yet only about 100 of them are intoxicants (such as alcohol, opioids, benzodiazepines, barbiturates, cocaine, hallucinogens, solvents, etc).

What do the intoxicants have in common, and how do they affect the brain? What mechanisms of action drive their ability to generate abuse and dependence? Through different biochemical pathways, intoxicants share a common final mechanism of action in the brain: they increase dopamine release in the nucleus accumbens (NAc) and the ventral tegmental area (VTA) (1). The NAc and the VTA are the core components of the reward system of the brain, and dopamine is the neurotransmitter that, when elevated in these nuclei, gives animals a positive, rewarding effect (2,3). This positive effect is salient, recognized and remembered by the brain, and the animal is eager to repeat the behavior that produces it. Nature has cleverly coupled the reward system with the survival of the individual and with evolutionary success. Throughout millions of

years of evolution, animals have relied on their reward systems to recognize what feels good and to repeat it. When an animal eats food, the levels of dopamine in the reward system increase by 50%, making the animal feel good. This prompts the animal to eat regularly, guaranteeing their survival. During sex, dopamine levels in the reward system double, making the animal eager to repeat intercourse and ensure the survival of the species.

In the case of the intoxicants known to man, the amount of released dopamine is typically much higher than the amount released by common pleasurable behaviors such as eating or sexual activity. Intoxicants therefore usurp and hijack the reward system of the brain, giving the organism powerful reasons to repeat using them despite negative consequences. Over millions of years of evolutionary history, repeating what feels good is synonymous with success. Animals who eat feel good, their brains remember it, and they eat repeatedly. This repetition contributes to the animal's survival. Repeated sexual activity feels good and, by engaging in intercourse, animals pass on their genes and promote the survival of the species. When the nuclei composing the reward system (unaware of any negative evolutionary consequences of dopamine surges) sense a dramatic increase of dopamine (above and beyond what food or sex produce) they immediately equate it with survival and evolutionary success. For the addict, the drug is survival. Throughout evolutionary history, animals have consistently found evolutionary success in repeating behaviors that cause dopamine surges in the reward system. Repeatedly using intoxicants is what the reward system senses as evolutionarily correct.

In the case of humans, the quest of the reward system to make addicts repeatedly use intoxicants results in the development of maladaptive behaviors (lying, cheating, stealing, being selfish, etc). These maladaptive behaviors are symptoms of the illness and not life-long character defects. Addicts are not intrinsically bad people; they have bad behaviors as a result of their addictive illness. These bad behaviors are actually quite useful to the reward system's quest to repeat what feels good since they increase the chances that an addict will use. In a way, these maladaptive behaviors serve well the evolutionary goal to repeat what feels good.

Addicted animals are doomed to use intoxicants repeatedly even if this repetition leads to death by causing animals to neglect real survival needs such as

food or water. A given species is likely to disappear if its members neglect sexual behaviors in favor of using drugs, since drugs produce a more pleasurable effect. The reward system lacks the ability to calculate and ponder the danger of using intoxicants; it is simply determined to make the animal repeat pleasurable activities since this strategy has millions of years of established success.

Humans, unlike other species, have very developed frontal lobes. It is in the frontal lobes that higher cognitive functions take place. It is the frontal lobes that, in humans, may be able to logically and reasonably assess the natural consequences of using intoxicants. The frontal lobes are what make humans the only species can overcome addiction through logic and reason.

Can the human frontal lobes, then, counteract the urges of the reward system? Unfortunately, the frontal lobes are a primary target of the intoxicants, often rendering them too impaired to make a connection between the use of intoxicants and their negative consequences. The chronic use of addictive drugs results on hypofrontality. Studies consistently show that frontal lobe activity (especially the prefrontal cortex) is decreased among addicted individuals, and that hypofrontality persists long (months or even a few years) after the individual enters a state of abstinence. Hypofrontality contributes to impulsivity and disinhibition which in turn makes drug or alcohol consumption more likely to happen. The frontal lobes are the seat of higher cortical functions (planning, organizing, morals and a sense of right and wrong). Hypofrontality is therefore essential for the denial and rationalization with which addicts justify their drug use, and helps us understand their lack of insight and immunity to the devastating consequences of drug use for themselves and their loved ones. The hypofrontal addicted brain seems incapable of modifying a conclusion ("drugs are not a problem for me") even if overwhelming evidence to the contrary is systematically presented to it. While non-addicts may modify such a conclusion based on data, addicts misinterpret any data presented to them to keep justifying their belief that "drugs are not a problem for me".

Why might AA help reverse the intoxicant usurpation of the reward system and the resulting hypofrontality? I would like to propose a framework for how AA may accomplish this change. This framework will be better understood if we review

Dr. Bob's "prescription for alcoholics", a three-step process written in 1937 that eventually developed into the current Twelve Steps (Figure 1):

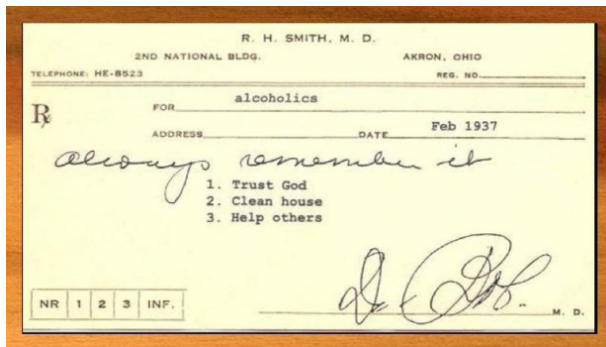


Figure 1. The three-step process written in 1937.

1. Trust God
2. Clean House
3. Help others

The Twelve Steps of AA, as published in the first edition of the book *Alcoholic Anonymous* (4) in 1939, were:

1. We admitted we were powerless over alcohol - that our lives had become unmanageable.
2. Came to believe that a Power greater than ourselves could restore us to sanity.
3. Made a decision to turn our will and our lives to the care of God *as we understood him*.
4. Made a searching and fearless moral inventory of ourselves.
5. Admitted to God, to ourselves, and to another human being the exact nature of our wrongs.
6. Were entirely ready to have God remove all these defects of character.
7. Humbly asked Him to remove our shortcomings.
8. Made a list of all persons we had harmed, and became willing to make amends to them all.
9. Made direct amends to such people wherever possible, except when to do so would injure them or others
10. Continued to take personal inventory and when we were wrong promptly admitted it.
11. Sought through prayer and meditation to improve our conscious contact with God *as we understood Him*, praying only for knowledge of His will for us and the power to carry that out.
12. Having had a spiritual awakening as the result of these steps, we tried to carry this message to alcoholics, and to practice these principles in all our affairs.

As can be seen, the first Step evolved into Steps 1, 2 and 3. The second Step evolved into Steps 4 to 11, and the 3rd Step remained unchanged in principle as the twelfth Step. Coherence between the steps and what we know about the neurobiology of the addicted brain can therefore be explained as follows:

1. Addicts are often unable to use logic and reason to work their way out of their addiction. Due to drug-induced hypofrontality, actively addicted individuals lack insight into their condition and its severity. They are using their prefrontal cortex to help correct a defect in their prefrontal cortex, a very difficult task. Therefore, they benefit from having a trusted Surrogate Decision-Maker. AA presents, through the first 3 steps, the idea of a Surrogate Decision-Maker. "You can't do it alone" is an important component of AA's therapeutic effect. Although the first 3 steps talk about a higher power (God *as we understood Him*), in practice it is often the AA group itself or the AA sponsor that acts as a Surrogate by emphasizing the addict's inability to beat addiction alone.
2. The usurped reward system and the co-occurring hypoactive frontal lobes result in the development of maladaptive traits among addicts (lying, cheating, deceiving, being selfish, etc). These maladaptive traits are actually quite useful to the reward system when trying to accomplish its main goal, repeating what feels good, which it equates with success for the individual and for the species. Steps 4-10 and step 12 promote the practice of opposite, compensatory behaviors: honesty, selflessness, altruism, etc. This Behavioral Compensation is therefore a form of behavioral rehabilitation that disarms the reward system of the tools (maladaptive behaviors) necessary to promote the use of intoxicants.

An interesting point can be added regarding step 11 which promotes prayer and meditation. Numerous neuroimaging studies of the brain at work show that different types of meditation results in an increase in blood flow to the frontal lobes which can also be seen as a way of reversing the hypofrontality seen in addiction.

In summary, the Twelve Steps of AA show coherence with our current knowledge of the neurobiology of the disease of addiction because:

1. Steps 1, 2 and 3 promote the use of a necessary Surrogate Decision-Maker
2. Steps 4 to 10 and Step 12 promote the use of Compensatory Behaviors

3. Step 11 promotes increased blood flow to the frontal lobes and contributes to reversing drug-induced hypofrontality.

Disclosures: The author has no financial conflicts of interest to report.

Corresponding autor.

Luis A. Giuffra
e-mail: LGiuffra@ClaytonBehavioral.com

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Recibido: 11/12/2015 Aceptado: 21/03/2015
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