

An Integrated Model of Addiction: When Will We Integrate Biological and Affective Processes?

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Abstract

Our work on addictions [1] has led us to the idea that the relative risk of an individual, his/her risk trajectory is the product of a double history: a biological history will generate resistance to the effects of sensations, an affective history will generate alexithymia, the inability to identify one's emotions. The biological history will produce incentives to increase the doses of psychoactive substances uses, the levels of risk taken and the frequency of transgressions to feel (finally) something; the affective history will produce incentives to replace the lost emotions by compulsive sensation seeking (whether intense or novel sensations) aiming vainly to find again the primitive emotions.

Keywords: Addiction; Attachment; Risk-taking; Development

First, The Relation To Risk Is From Birth In A Pendulum Between The Two Basic Needs

This double history has a complex and interactive nature, as the relationship to risk is never one-dimensional but is built in a series of interactions protection and exploration need for security and novelty. The prototype of this pendulum is the attachment between mother and infant, and then gradually extend to all areas of expression of these drives (for example, the use of psychoactive substances may aim to end a negative situation - anxiety or lack - or instead to seek a new positive situation through the psychotropic effects of the products).

4. Then, as said by Blaise Pascal ("The heart has its reasons that reason does not know") and as suggested by dual-process social cognition models [2] the risk of psychoactive substances use is managed by the subject with the two systems of thought he/she has access to: analysis and experience. The analytical system is conceptualized as logical, conscious, slow, and capable of using abstract representations, whereas the experiential system is based on concrete representations, emotional, the signals are determined by past experience and a faster processing is oriented towards immediate action, in short, emotional heuristics (risk will be connoted with a valence of affect).

These two systems operate in parallel and at times one outweighs the other in our decisions. We will see later how the interactions between emotions and sensations guide these operations.

The Biological History Links Addictions, Rewards and Sensations

Addictions may be analyzed as a way to satisfy a need - sensation seeking - which aims to optimal brain activation. This need may itself correspond to various psychological functions, such as self-regulation. For example, longitudinal studies have shown that the increase in sensation seeking during adolescence, accompanied by a concomitant increase in risk behavior is a significant predictor of excessive alcohol and cannabis use in adulthood.

Sensitivity to reward may be an important marker of the relationship between personality and addiction. Studies in neuro-imaging have examined the relative rate of neuronal development in the brain areas that are involved in the system controlling the decisions about rewards. These works suggest a positive correlation between novelty seeking and the volume of gray matter in the prefrontal and parietal regions.

Given the prevalence of risk behaviors during adolescence, neurobiological differences in sensitivity to reward are studied by functional magnetic resonance imaging (fMRI): young strong sensation seekers show a stronger response in bilateral insular prefrontal cortex during reward situations. As the prefrontal cortex regulates attentional behavior, we deduce that strong sensation seekers allocate less attentional resources to the absence of reward. This lack of sensitivity can lead to more inappropriate decisions when negative consequences are not taken into account, thus taking risks, and lack of sensitivity to loss can lead to addiction.

This sensitivity to reward has been studied mainly in its aspect of risk factor for risk-taking, addiction, transgression. What is less known is that it has two sides, and can also act as a protective factor: the increased sensitivity to reward may also potentially be an asset for teens when engaged in prosocial activities. Thus, the increased activation of the ventral striatum in obtaining prosocial rewards predicts subsequent decrease in risk taking. So, it is the same cortical area that both confer vulnerability to addiction and a protective effect against addiction! For prevention, the challenge would be to direct the emotions of adolescence to these protective activities ... We find here a very Christian conclusion, only the other can save us from danger!

The Dual Agenda

Psychoactive substances use at adolescence is built in the confrontation of two agendas: the activation of the socio-emotional reward system in the limbic areas at puberty by the hormone testosterone secretion, and the construction of synaptic connections with the cognitive control of decisions systems in the prefrontal areas. The period which extends between adolescence and adulthood seems to be a period of "tuning" due to better connectivity between

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prefrontal and limbic areas, which leads to better cognitive control of emotions [3]. As long as this tuning is not performed, adolescence is a period of vulnerability, because the two systems, socio-emotional and cognitive control, conflict in decision-making and risk-taking. When the emotional system prevails over the other or beyond its ability to adapt, the consequence may be substance misuse, in the sense that the subject will enhance the more immediate benefits rather than the long-term costs.

Contrary to stereotypes, teenagers are not more emotional than adults, their limbic areas are not particularly more activated than those of adults by emotional stimuli, but rather the difference lies in the fact that adolescents activate simultaneously less cortical and subcortical areas, resulting in poorer synchronization of cognition and affect. It is for this reason that adolescents, more than adults, may react without thinking (the primacy given to the affect) or do not act because they are stuck on reflection, and much longer than adults, two opposite phenomena with the same biological cause. Thus, it is not that affect dominates the thinking that is the problem, it is the lack of coordination between affect and thought.

The effect of such coordination on the resistance to peer pressure has been shown by brain imaging: the subjects most susceptible to peer pressure issues are those that activate more areas involved in the perception of others' actions, then the least sensitive subjects to peer pressure issues are those that have the best connectivity between these areas and the areas of cognitive control decision. This better coordination between frontal and striatal areas can counter impulsive susceptibility to peer pressure, and we know how peer pressure may be an important risk factor for alcohol or cannabis use.

The dual agenda leads to the idea that addiction is a matter of tempo! Or, more precisely, of two different tempi, between the fast socio-emotional system at puberty, and the much slower system of cognitive control. This allows also to understand why early puberty and early initiation of psychoactive substances are predictive risk factors of addictions late in life: they occur at the time of life when the prefrontal and executive functions does not yet control the limbic system and the rewards.

Finally, we see the strong interaction between addictions and socialization, in relation to the construction of risk in adolescence. The reason is that the presence of peers stimulates the reward system areas (ventral striatum and orbitofrontal cortex), whereas the activities of the cognitive control of decisions areas do not vary depending on the social context. Thus, the presence of peers may increase alcohol or cannabis use at this period of life, by increasing sensitivity to potential rewards of psychoactive substance use. This risk is fundamentally social in this moment of existence!

Interrelations of risk behaviors and markers

As we mentioned above, precocious behavior is a marker. Thus, the earlier the initiation of drinking, the stronger the risk of progression to alcohol dependence and of traffic accidents caused by alcohol.

The age of initiation is a marker because it raises the questions of what it covers and what pushes the subject to consume so early. Similarly, the literature shows that subjects who engage in risky sexual behavior in adolescence are more likely to engage in these behaviors in adulthood. For example, a younger age at first intercourse is associated with risk behaviors such as unprotected sex or multiple sexual partners.

It has also been shown that the frequency of alcohol consumption

in adolescence may be a predictor of sexual risk of HIV among adults, the relationship has been observed in men but not in women. Frequent alcohol consumption can be a direct cause of sexual risk behaviors, but it can also serve as a potential marker of risk behaviors, including those that increase the risk of HIV infection.

Precocity as a marker will indicate the risk factors that includes: genetic factors, quality of emotional attachments, lack of parental supervision, parenting behaviors and intergenerational transmission, peer influences (or selection of peers), impact of subjective norms and social modeling, influences of the neighborhood where you live.

Resistance to the effects of sensations, a genotype / environment interaction?

(From which it appears that individuals feeling little are in great danger ...)

In the field of addictions, a genotype / environment interaction has been shown about the heritability of sensitivity to the effects of alcohol in sons of alcohol-dependent fathers, about the resistance to the effects of the sensations produced by alcohol : these young people, on which alcohol does little effect, precisely because they feel few effects of stimulation, will gradually increase the doses to feel "something" ... to be "connected", "Sync "with their friends on which alcohol produces many more sensations. This will constitute a risk factor for excessive consumption and alcohol dependence [4]. So, what is basically a genetic vulnerability highlighted by behavioral genetics gradually combines with an environmental effect, the Saturday night socialization ... The novelty of this type of investigation should lead us to be cautious in the interpretation and these results will obviously have to be confirmed, but they may already be associated with the genetic epidemiology of alcoholism.

So, siblings have increased tolerance to the initial effects of alcohol, and this initial tolerance is one of the most predictive markers of alcohol misuse, yet it is quite remarkable that the marker identified in these siblings, the "alpha5 -alpha3-beta4 ", the first gene of vulnerability that has been clearly discovered about addictive disorders, including tobacco dependence: it is actually a cluster of genes encoding subunits of cholinergic receptors in the ventral striatum and nucleus accumbens, the latter structure playing an essential role in the analysis of the rewards produced by stimulation.

One could imagine that this resistance to the effects of sensations produced by alcohol exists in other areas: sports, road, etc.. Indeed, the same stimulation does not cause the same sensation in all of us: you put someone on a ride ... and he/she screams! You take another one on the most "sensational" Disneyland attractions and he/she comes down saying ... I did not feel anything! One could imagine future works in behavioral genetics and developmental psychology on this topic ...

The affective history

In the wake of Bowlby attachment theory[5], a series of studies has demonstrated the influence of the quality of the emotional relationship between the subject and his/her parents during childhood on the addictions of the teenager[1].

Anxiously attached adolescents are more likely to engage in potentially dangerous behaviors. It is the overall system of representations of the individual which is involved: adolescents who have a secure attachment are more able to manage the risks of this period of life.

At adolescence, the emotional support of parents is associated with better self-esteem, less peer pressure and less engagement in risky behaviors (alcohol, illicit drugs, unprotected sexual behavior, delinquency, indiscipline in schools, traffic safety); helping to build a better self-image, a secure attachment allows a less risky exploration of the environment.

Two variables mediate the link between attachment insecurity and addiction:

a) Alexithymia (from a privative, *lexi* “read” or “name”, and *thymia* “emotion”, this term refers to the fact of not having words for one’s feelings, to be blind to oneself).

This multidimensional concept has four components and refers to the inability to identify, distinguish, verbalize to others his/her own emotions, and an operational thinking that emphasizes the practical aspects at the expense of the emotional aspects. This attitude is often cited as a risk factor for psychosomatic disorders, post-traumatic stress disorder, acting out, eating disorders and substance abuse. Alexithymia is particularly harmful about negative emotions, such as hostility to self. Excessive psychoactive substances users are precisely characterized by this combination: they experience more often negative emotions, and they are less able to identify these, so you have to help them to recognize this “inner anger”.

b) Self-regulation

This mechanism is based on attentional processes. We can focus our attention on others, on the outer world, but when we bring it on ourselves, there is a gap between what we are and what we want to be, between the self and the ideal self. In this case, a way to reduce this tension, this dissonance is to divert the attention of the problem in question. For this, the individual will implement his/her system of activities. We are engaged in various daily activities, but with a common goal: to restore self-esteem. In this perspective of self-regulation, two strategies are available to solve this problem: self-escape, no longer pay attention to yourself, distract yourself to not be confronted with his/her disability or failures - or self-compensation, switch to another source of self-esteem, find another source of self-worth to compensate one’s disability or failures, which may be called the compensation of the self.

One or the other end of this alternative is more likely based on certain conditions: the substitution is more likely when the subject has several sources of self-esteem. Thus, the complexity of self-concept (number and independence of aspects) predicts the objectives of the physical and psychological responses to stress: high levels of complexity are associated with less extreme reactions (because there are possible compensations during stressful life-events), by cons, depression is more likely with low complexity.

If some activities have clearly a function of escape (psychoactive substances use) and if others have a compensation function (mountaineering practiced by mountain guides, driver training led by former young “speeders” who become driving instructors, childminders job for former abandoned children, etc.), most risk behaviors can be ambivalent and it is necessary to have a clinical understanding of the circumstances and consequences of the action.

Integration of both histories in a developmental psychopathology model

In a recent publication[6], we proposed a review of research leading to a theoretical model of developmental psychopathology of family

influences (Figure 1) and founded on the concept of « developmental cascade » (a cause produces an effect which becomes the cause of something else).

We have grouped different aspects of what constitutes a family environment into five broad dimensions following the chronological development of the young person:

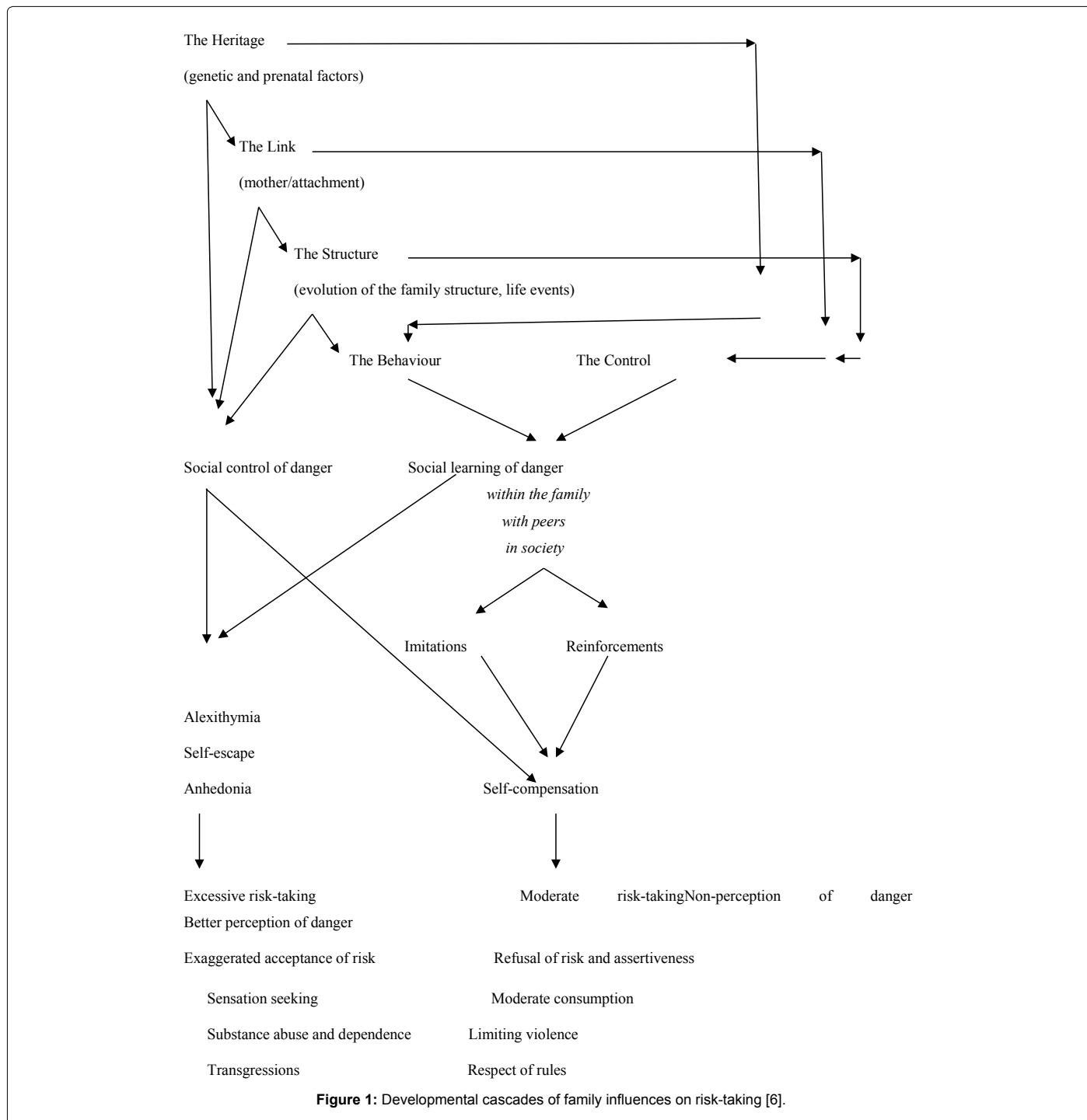
1. Our biological heritage, the effect of genetic and prenatal factors.
2. Our bonding with our principal attachment figure, who is generally the mother.
3. The evolution of the family structure during the subject’s childhood, and principally the effects of parental separation.
4. The influences of our parents’ behaviours.
5. Our parents’ educational style, the type of control of their child’s behaviours.

For example, there are many examples of the illustration of intergenerational transmission of behaviours in the literature: consumption, for young people, is statistically linked to the tobacco habit of each of their parents. The more the parents smoke, the more prevalent their children’s smoking. Hence, when neither of the two parents smoke, 23 % of young people smoke every day, as against 50,5 % when one of the parents regularly smokes at least ten cigarettes a day and 61,2 % when they both smoke the same number. It is as if there is a dose/effect relationship!

In the Hutchinson longitudinal study, 3 000 American children were monitored from the age of 8 to 18 , with information about their parents’ use of tobacco when the children were aged 8, and this gave the most pertinent and reliable answers; there is indeed a progressive graduation of the risk that the child become a regular smoker at the age of 18 in function of the number of parents who smoke: when one parent smokes, there is an increase of 64 % of the risk of addiction for the young person (relative risk of 1,90) as compared with households where neither parent smokes, when both parents smoke, this adds a further increase of 25 % of risk (relative risk of 1,39) as compared with households where only one parent smokes; thus, in total, having both parents who smoke multiplies the risk of the child becoming addicted to by 2,65 . Lastly, there seems to be no differences in function of the sex of the parent, nor of the child, nor of matching: the father does not influence his son more than the daughter, the mother idem.

It remains to be defined just how the interactions with the effects of the evolution of the family structure (divorce, etc.) function: having two parents who smoke has no doubt more effects when both parents live under the same roof ... and, with reconstituted families, we need to study influences of the behaviours of the four ... « parents »... which becomes rather complicated! It also remains to study the question of the effects of rules at home (which will be the subject of the next chapter): certain rules (no smoking in the house) are protective, even if the parents are smokers, on the other hand, some educational practices (e.g. punishing the adolescent when he smokes) is not protective if the parents smoke themselves ... Finally, we need also to study how all these factors impact behaviour modifications of the young person, for example, when he progresses from weekly consumption to daily use ...

Nonetheless, transmission phenomena cannot be reduced to mere imitations: the use of psychoactive substances by the mother also reflects family malfunctioning or psychological distress, which will also encourage the young person to use tobacco. In fact he may depend



more on the psychological distress of his mother and its effects, than on his own consumption of psychoactive substances. It has thus been shown [7] that the mother's emotional distress was very important in substance initiation for young adolescents (12-14 years old) whereas it intervenes less for older adolescents (15-18 years).

Furthermore, influence of the father's dependence on psychoactive substances on the use of psychoactive substances by adolescents causes different phenomena (regular alcohol use at an earlier age, higher rate of consumption and the use of cannabis for his child) and is

exerted in two ways, as was shown in longitudinal studies [8] : one is a direct influence via social modelling, the other indirect, and, more importantly, mediated by the personality of the young person.

Personality characteristics which mediate this relationship between usage by the father and son are impulsiveness, disinhibition. This corresponds to the conclusions of a prior study by Chassin *et al.* [9] on 450 subjects from Arizona: the most frequent trajectory is a moderate use of alcohol and of illicit drugs which increases between the ages of 15 and 25 (with a high point at 21) and then decreases. Amongst the group

of those who become dependent, either on alcohol or on illicit drugs, or else both (20 % of the subjects in this study!), parental alcoholism is one of the important predictive factors. It is not mediated by parental psychopathology.

On the other hand, the link between family history of alcoholism and illicit drug abuse or comorbidity is mediated by the young person's personality (impulsiveness and low popularity). It is indeed possible that young people who display these characteristics will use substances to regulate negative affects. Thus, children of alcohol-dependent parents who are impulsive will more often have bad school results, be rejected by « conformist » peer groups, affiliated with peer groups who will model their substance use, and be less dissuaded by negative consequences of usage.

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