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Peer Influence and Addiction Recurrence

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Abstract

In this paper we highlight the role of peers in the recurrence of addictive behavior. To do so, we use a simple "forward looking" model with procrastination and peers influence. Our results show that while procrastination can explain the decision to postpone rehabilitation, peers influence is essential to explain the cyclical patterns of addiction-rehabilitation-addiction.

Key words: *Addiction, peer effects, rehabilitation*

JEL Classification: I12, Z13.

Résumé

Dans cet article nous analysons l'influence des pairs dans la récurrence de la dépendance. Nous utilisons un modèle simple avec procrastination et influence des pairs. Nos résultats indiquent que même si la procrastination peut expliquer la décision de repousser à plus tard la désintoxication, l'influence des pairs est essentielle afin d'expliquer les comportements cycliques de dépendance-désintoxication-dépendance.

Mots clés: *Dépendance, effets de pairs, désintoxication*

Classification JEL: I12, Z13.

1 Introduction

> Our common welfare should come first; personal recovery depends upon alcoholics anonymous unity.
>
> [Alcoholics Anonymous (1972), A Brief Guide to Alcoholics Anonymous.]

Addictive behavior, in all its forms, is a social problem that is very present in every day life: gambling, binge drinking, smoking, substance use, over-eating, caffeine addiction, work addiction etc... There is a precious body of theoretical as well as empirical literature that has tackled a wide variety of addictive behaviors from different perspectives namely, myopia and habit formation (Lewit & Coate 1983, Baltagi & Levin 1986, Jones 1989, Jones 1994) as well as stock accumulation (Becker & Murphy 1988, Dockner & Feichtinger 1993, Orphanides & Zervos 1998, Baltagi & Griffin 2001). Particular attention was given to the role of cumulative consumption in explainning addiction and its recurrence. The decision to consume addictively, to stop, or to engage in cyclical patterns of addiction-rehabilitation-addiction, in this case, was considered to be endogenously determined.[1] While a person's consumption habit over time constitutes an important determinant of addictive behavior, we are inclined to think that addictive behavior has more than one dimension. This is why we choose to tackle addictive consumption and its recurrence from another angle. Particularly, we focus on the importance of social interaction with peers in shaping addictive consumption habits and its incidence on recurrence.

The empirical literature on the impact of peers in general, and the impacts of peers on addictive behaviors in particular, has been very active (Jones 1994, Borsari & Carey 2001, Duncan, Boisjoly, Kremer, Levy & Eccles 2005, Lundborg 2006, Kremer & Levy 2008). Nevertheless, to our best knowledge, little attention was given to role of external factors such as social interaction in explaining the recurrence of addictive behavior from a theoretical perspective.[2] In this paper, we attempt to fill this gap in the literature by introducing the impact of peers in a simple "forward looking" framework with procrastination (Akerlof 1991).[3]

[1] Through myopia and habit formation or stock accumulation.

[2] We use external factors or exogenous factors interchangeably to refer to factors that are not endogenously determined by the model.

[3] It is important to note that while empirical evidence show that the "forward looking" assumption is verified, there is no evidence that the time consistent preference is verified (Gruber & Koszegi 2001). Also there is a wide evidence both empirical and experimental that points toward time inconsistent preferences

One may argue that the consumption of an addictive substance remains a personal choice of a "forward looking" agent. However, social interaction with peers and the cost of "non-conformity" play a non-negligible role in initiating and shaping the consumption of addictive substance. Peer effects may then be perceived as an externality. In this perspective, it is important to provide a close look on the role of such exogenous forces on the recurrence of the addictive behavior. If peers play a determinant role in the recurrence of addictive behaviors, then it might be efficient to exploit this information while addressing addiction problems. The remainder of the paper is organized as follows. Section two introduces our model. Section three presents a simple model with a forward looking agent. Section four adds procrastination to the basic model and section five incorportates the impact of peers. Finally, section five concludes.

2 The Model

We consider an agent making an inter-temporal decision over an addictive good x. For simplicity, we assume that the choice of this agent is limited to three levels of consumption: 0, if he decides not the consume the good, x^*, if he consumes the good socially and $x^{\max}$ if he is addicted. At time $t = 0$ the agent is not addicted, so he has two choices: he may consume 0 or x^*. If he decides to engage in consumption, there is a probability π that he becomes addicted at period 1. If he is not addicted at period 1, we assume that the agent is then able to consume the good "socially"(i.e. x^*) and will never become addicted. If he becomes addicted, his consumption remains at $x^{\max}$ as long as he does not engage into rehabilitation. We assume that there is a fixed cost $\gamma > 0$ for rehabilitation. We also assume that once rehabilitated, the agent can choose to stay clean forever or to consume again. If the agent decides to consume again he will consume the addicted level $x^{\max}$.

Let assume that the net benefit of consumption, $B(\cdot)$ is given by:

$$B(x_t) = \begin{cases} 0 & \text{if } x_t = 0 \\ B^* & \text{if } x_t = x^* \\ B^{\max} & \text{if } x_t = x^{\max} \end{cases} \tag{1}$$

We assume that $B^* > B^{\max} > 0$.

(Thaler 1981, Benzion, Rapoport & Yagil 1989, Angeletos, Laibson, Repetto, Tobacman & Weinberg 2001, Laibson, Repetto & Tobacman 2007)

Let assume that consuming the addictive good at time t induces a health cost $H(\cdot)$ at time $t+1$. This health cost is given by:

$$H(x_t) = \begin{cases} 0 & \text{if } x_t = 0 \\ H^* & \text{if } x_t = x^* \\ H^{\max} & \text{if } x_t = x^{\max} \end{cases} \tag{2}$$

We assume that those health cost are such that benefit from consuming at the social level B^* is greater than the discounted health costs, βH^*. We also assume that the benefit from an addictive consumption $B^{\max}$ is less than the discounted health costs incurred from an addictive consumption $\beta H^{\max}$, where β is the inter-temporal discount factor.

3 The forward looking agent with time consistent preferences

In this section we present a simplified model of "rational addiction". In this framework, the agent chooses to consume the addictive good if the discounted values of the consumption stream exceeds its discounted cost. This net value of consuming the addictive good is given by:

$$\begin{aligned} V_0 &= B^* + \pi \max\left(\sum_{t=1}^{\infty} \beta^t (B^{\max} - \beta H^{max}) - \beta H^*, -\beta(\gamma + H^*)\right) \\ &\quad + (1-\pi) \sum_{t=1}^{\infty} \beta^t (B^* - H^*). \end{aligned} \tag{3}$$

A close look at (3) indicates that while taking his decision at time 0, the agent anticipates that if he becomes addicted he would chose the best option between engaging into rehabilitation permanently or consuming addictively forever. If he does not become an addict, then he will keep on consuming the social level x^*.

Proposition 1 *A forward looking agent with time consistent preferences chooses to consume the addictive good if $V_0 > 0$. If he becomes addicted, the agent*

1. *stays addicted forever if $\gamma > -\sum_{t=0}^{\infty} \beta^t (B^{\max} - \beta H^{\max})$ or,*
2. *chooses rehabilitation and never consume again if $\gamma \leq -\sum_{t=0}^{\infty} \beta^t (B^{\max} - \beta H^{\max})$.*

In this model, the agent has time consistent preferences. If the agent chooses to rehabilitate, then recurrence is impossible. In fact, the agent fully anticipates that the intertemporal utility of re-consuming the addictive good is negative once rehabilitated. In this context, policies affecting the net benefit of consumption, B or the cost of rehabilitation, γ will affect the consumption of addictive goods. However, as pointed out by Akerlof (1991), the application of such models, combined with utilitarian ethics, leads to the conclusion that no intervention on the substance market is economically sound in absence of a consumption externality.

4 The impact of procrastination

Akerlof (1991) argues that rational addiction models do not accurately describe individuals' drug or alcohol consumption decisions. He further argues that most drug users consider that the long term cost of their addiction exceeds its benefits. They all intend to cut down on their consumption, but tend to procrastinate their decision to stop.

> Actions like smoking a cigarette, having a drink, eating a candy bar, and working overtime to "catch up" all lead to immediate and certain gratification, whereas their bad consequences are remote in time, only probabilistic, and still avoidable now. It is no contest: Certain and immediate rewards win out over probabilistic and remote costs, even though the rewards are slight and the possible costs lethal.

[quoted in Akerlof (1991) from Brown (1986)]

To account for procrastination, Akerlof (1991) introduces an extra salience factor for actual benefits and/or costs.[4] Let δ denote this extra salience parameter, then the initial present value of engaging into substance consumption becomes:

$$\begin{aligned}\widehat{V}_0 &= (1+\delta)B^* + \pi \max\left(\sum_{t=1}^{\infty}\beta^t(B^{\max} - \beta H^{max}) - \beta H^*, -\beta(\gamma + H^*)\right) \\ &\quad +(1-\pi)\sum_{t=1}^{\infty}\beta^t(B^* - H^*). \end{aligned} \tag{4}$$

[4] It is important to note that Akerlof's representation is mathematically equivalent to hyperbolic discounting.

A peculiar thing with procrastination is that the extra salience parameter is always applied on present benefits and costs as time moves on, but the agent does not anticipate this change in his own preferences. This implies that the present value at any time $t \neq 0$ is given by:

$$\widehat{V}_t = \begin{cases} (1+\delta)B^* + \sum_{i=1}^{\infty} \beta^i (B^* - H^*) & \text{if not addicted} \\ \max\left\{(1+\delta)B^{\max} - \beta H^{\max} + \max\left(\sum_{i=1}^{\infty} \beta^i (B^{\max} - \beta H^{max}), -\beta\gamma\right), \right. \\ \left. -(1+\delta)\gamma\right\} & \text{if addicted} \end{cases} \quad (5)$$

In equations (4) and (5), the agent's preferences are not time consistent. This is due to the presence of an extra-salience parameter, δ. In this context, an addicted agent may always plan to stop his addictive behavior tomorrow. This would be the case if $\widehat{V}_t > 0$ and $\sum_{i=1}^{\infty} \beta^i (B^{\max} - \beta H^{max}) < -\beta\gamma$.

Proposition 2 *An agent subject to procrastination chooses to consume the addictive good if* $\widehat{V}_0 = V_0 + \delta B^* > 0$. *If he becomes addicted, the agent*

1. *stays addicted forever if* $(1+\delta)\gamma > \beta(\gamma + H^{\max}) - (1+\delta)B^{\max}$ *or,*

2. *chooses rehabilitation and never consume again if* $(1+\delta)\gamma \leq \beta(\gamma + H^{\max}) - (1+\delta)B^{\max}$.

Thus, the addicted agent stays addicted forever if the cost of disintoxication tomorrow is perceived to be less than the cost of disintoxication today. Also, the addicted agent would chose to cut off the addictive consumption forever, if the value of δ is such that rehabilitation is less costly today. Proposition 2 has two implications. First, the agent may engage into consumption even if it is not a sound economic decision from an inter-temporal perspective. This occurs when $V_0 < 0$ and $\delta B^* > -V_0$. Second, the agent may possibly postpone his rehabilitation at each period, even if rehabilitation is a sound economic decision. It is important to emphasize that in both cases, there is room for implementing a public health policy on addictive substances. Any intervention that may reduce the expected benefit or increase the expected cost of substance use can be considered a sound economic policy. Also, any policy that reduces the cost of rehabilitation can also help circumscribe the problem associated with procrastination. Nevertheless, even if rehabilitation is free (i.e.

$\gamma = 0$), it is still possible that an addicted consumer postpones rehabilitation forever if $(1+\delta)B^{\max} > \beta H^{\max}$. Before introducing the impact of peers in the framework, we would like to mention that if an agent decides to rehabilitate, he will never choose to consume again. This implies that the presence of extra salience in the agent's preferences cannot explain the recurrence of addictive behavior.

5 The impact of peer influence

The consumption of many addictive substances are often associated with socialization with a group of peers. For example, van den Bree & Pickworth (2005), using the National Longitudinal Study of Adolescent Health, find evidence that allows for the conclusion that a peer's involvement in marijuana consumption increases the risk of marijuana consumption and addiction. To capture these effects in our model, we assume that there is a cost ϕ of deviating from the group's norm of consumption. In this context, social interaction must be taken into consideration when analyzing the agent's behavior. For simplicity, we assume that this peer effect is only salient; the agent does not anticipate future group consumption. We also assume that there are N agents, $n = 1, 2, ..., N$ such that agent i's net benefit of consuming at time $t = 0$ is given by:

$$\widetilde{V}_{i0} = \max\left(\widetilde{V}_{i0}^{*}, \widetilde{V}_{i0}^{\max}\right) \tag{6}$$

where,

$$\begin{aligned}\widetilde{V}_{i0}^{*} &= (1+\delta)B^{*} - \beta H^{*} + \pi \max\left(\sum_{t=1}^{\infty}\beta^{t}(B^{\max} - \beta H^{max}), -\beta\gamma\right) \\ &\quad + (1-\pi)\sum_{t=1}^{\infty}\beta^{t}(B^{*} - \beta H^{*}) - \phi|x^{*} - \overline{x}_{0}|, \end{aligned}\tag{7}$$

$$\begin{aligned}\widetilde{V}_{i0}^{\max} &= (1+\delta)B^{\max} - \beta H^{\max} + \pi \max\left(\sum_{t=1}^{\infty}\beta^{t}(B^{\max} - \beta H^{max}), -\beta\gamma\right) \\ &\quad + (1-\pi)\sum_{t=1}^{\infty}\beta^{t}(B^{*} - \beta H^{*}) - \phi|x^{max} - \overline{x}_{0}|, \end{aligned}\tag{8}$$

and, $\overline{x}_0 = \frac{1}{N-1}\sum_{n=1, n\neq i}^{N} x_{n0}$

The presence of peer influence and thus the cost associated from the deviation from peers' behavior, introduces a new possibility: the agent may consume the addictive quantity directly in the first period even if he is not physically addicted.[5] This was impossible in the previous two sections since we had $B^* - \beta H^* > B^{max} - \beta H^{max}$. The introduction peers' influence disturbs this strict inequality. In fact, the net benefits from consuming the social quantity are no longer necessarily greater than the net benefits from consuming the addictive quantity, $B^* - \beta H^* - \phi(x^* - \bar{x}) \gtrless B^{max} - \beta H^{max} - \phi(x^{max} - \bar{x})$. As in the preceding section, the extra salience parameter is always applied on present benefits and costs as time moves on, but the agent does not anticipate this change in his own preferences. The same thing applies to the group's norm. This implies that the present value at any time $t \neq 0$ is given by:

$$\widetilde{V}_t = \begin{cases} \begin{array}{c} \max\left\{(1+\delta)B^* - \beta H^* - \phi|x^* - \overline{x}_t|, (1+\delta)B^{\max} - \beta H^{\max} - \phi|x^{\max} - \overline{x}_t|\right\} \\ + \sum_{i=1}^{\infty} \beta^i (B^* - \beta H^*) \end{array} & \text{if not physically addicted} \\ \begin{array}{c} \max\left\{(1+\delta)B^{\max} - \beta H^{\max} - \phi|x^{\max} - \overline{x}_t| + \max\left(\sum_{i=1}^{\infty} \beta^i (B^{\max} - \beta H^{max}), -\beta\gamma\right), \right. \\ \left. -(1+\delta)\gamma - \phi\overline{x}_t\right\} \end{array} & \text{if addicted} \end{cases} \tag{9}$$

In this framework, consumption by one agent creates an externality through peer effects. To simplify the strategic analysis of the model, we will, for the remainder of this section assume that $N = 2$. We start by analyzing the initial decision at time $t = 0$.

Proposition 3 *Consider two agents with identical preferences represented by $\widetilde{V}_{i0}^* = \widehat{V}_0 - \phi|x_{i0}^* - \overline{x}_0|$ where $i = 1, 2$. In this context,*

1. *if $\widehat{V}_0 < -\phi x^*$, then the dominant strategy equilibrium is necessarily such that no agent consumes the addictive good ,*
2. *if $\widehat{V}_0 > \phi x^*$, then the dominant strategy equilibrium is necessarily such that the two agents consume the addictive good,*
3. *if $-\phi x^* \leq \widehat{V}_0 \leq \phi x^*$, then two Nash equilibria are possible. In the first equilibrium both agents will consume the addictive good, in the other equilibrium, neither agent will consume the addictive good.*

[5]We say that an individual is physically addicted when it is impossible to stop without incurring the cost of rehabilitation. A person may consume the addictive quantity without being addicted, in this case the consumption is driven by the costs of deviating from peers' behavior.

Proposition 3 implies that it may be suboptimal to consume the addictive good if $V_0 \leq 0$. However, if $\widetilde{V}_{i0}^{*} > 0$, the agents may still consume socially the addictive good. This has two implications. First, the agents'consumption of the addictive good may be the outcome of a dominant strategy equilibrium. This is the case when the magnitude of the peer effects is insufficient to reverse the agents' decision. Thus, the decision to consume the addictive good may be economically sound or may result from procrastination. In such a context, policy interventions similar to the ones mentioned in section 4 will be adequate. Second, the agents' decision to consume the addictive good may result from a coordination problem. In this case, the Nash equilibrium with no consumption will be socially superior to the other equilibrium. Therefore, if both agents consume the addictive substance while it is suboptimal to consume, then peers' influence is reversing agents' decision.[6] Consequently, a policy intervention targeted towards their social network may lead to an equilibrium where both agents do not consume.

Once the decision of consuming the addictive good has been taken, three situations may occur: (1) both agent consume the good "socially" ($x_t = x^*$), (2) both agent are addicted or (3) one agent consume the good socially and the other one is addicted. In the first scenario, both agents' consumption is ex-post optimal in the sense that we know that neither of them will ever become addicted. Therefore, in the remaining of this section, we will focus our attention on the second and the third scenarios.

Proposition 4 *Suppose that the two agents consume addictively. In this case,*

1. *if* $(1+\delta)\gamma > \beta(\gamma + H^{\max}) - (1+\delta)B^{\max}$, *then the dominant strategy equilibrium is necessarily such that the agents will stay addicted forever,*

2. *if* $(1+\delta)\gamma < \beta(\gamma+H^{\max})-(1+\delta)B^{\max}-\phi x^{\max}$, *then the dominant strategy equilibrium is necessarily such that the agents choose rehabilitation and never consume again,*

3. *if* $\beta(\gamma+H^{\max})-(1+\delta)B^{\max}-\phi x^{\max} \leq (1+\delta)\gamma \leq \beta(\gamma+H^{\max})-(1+\delta)B^{\max}$, *then two Nash equilibria are possible. In the first equilibrium both agents stay addicted for one period, in the other equilibrium, both agents choose rehabilitation for one period. As the decisions are not time consistent, the equilibrium may switch between two periods.*

[6] Note that in this case the influence of peers acts as a negative externality.

Once again, although it may be optimal to engage in rehabilitation, the agents may choose not to rehabilitate. This has two implications. First, the agents' addictive behavior may be the result of a dominant strategy equilibrium. As in the previous proposition this may be economically sound or may result from procrastination. Second, the agents' decision not to rehabilitate may be due to coordination failure. Therefore, a policy intervention that forces the agents into rehabilitation may be optimal.[7] It is important to mention that in the multiple equilibria case, even if both agents choose to rehabilitate, there is no warranty that they will stay clean forever.

Corollary 1 *Consider the case where two addicted agents have decided to rehabilitate. In this case,*

1. *if* $\beta(\gamma + H^{\max}) - (1+\delta)B^{\max} - \phi x^{\max} > 0$*, then the dominant strategy equilibrium is necessarily such that the agents stay clean forever,*

2. *if* $\beta(\gamma + H^{\max}) - (1+\delta)B^{\max} - \phi x^{\max} \leq 0$*, then two Nash equilibria are possible. In the first equilibrium both agents stay clean for one period, in the other equilibrium, both agents choose to consume again. As the decisions are not time consistent, the equilibria may change between two periods.*

The contribution of Proposition 4 and Corollary 1 resides in the fact that it can explain observed cyclical pattern of consumption - rehabilitation - consumption. It is clear that in the context of this model, a policy intervention that targets the composition of the network of friends may be desirable from a rehabilitation perspective. The decision to rehabilitate and to stay clean forever, may be clearly influenced by the decisions taken in the network of friends. Thus, coordination failures may induce the agents to choose the wrong decision.

Turning our attention to the last scenario, rehabilitation may be optimal for one of the two agents while social consumption may be optimal for the other. However, this may not necessarily mean that such an equilibrium would materialize as such. The impact of procrastination and social interactions may well lead to other behavioral patterns.

[7] This is the case even if we adopt utilitarian ethics for those two scenarios.

Proposition 5 *Consider two agents, one of them being addicted while the other is not. In this case we have four potential Nash equilibria:*

1. *if* $\phi(x^{\max} - x^*) > (1+\delta)(B^* - B^{\max}) - \beta(H^* - H^{\max})$ *and* $(1+\delta)\gamma + \phi x^{\max} > \beta(\gamma + H^{\max}) - (1+\delta)B^{\max}$ *then both agents consume* $x^{\max}$*,*

2. *if* $\phi(x^{\max} - x^*) \leq (1+\delta)(B^* - B^{\max}) - \beta(H^* - H^{\max})$ *and* $(1+\delta)\gamma + \phi x^* > \beta(\gamma + H^{\max}) + \phi(x^{\max} - x^*) - (1+\delta)B^{\max}$ *then the addicted agent consumes* $x^{\max}$ *and the other agent consumes* x^**,*

3. *if* $(1+\delta)B^* - \beta H^* - \phi x^* > 0$ *and* $(1+\delta)\gamma + \phi x^* \leq \beta(\gamma + H^{\max}) + \phi(x^{\max} - x^*) - (1+\delta)B^{\max}$*, then the addicted agent chooses rehabilitation and the other agent consumes* x^**,*

4. *if* $(1+\delta)B^* - \beta H^* - \phi x^* \leq 0$ *and* $(1+\delta)\gamma + \phi x^* \leq \beta(\gamma + H^{\max}) + \phi x^{\max} - (1+\delta)B^{\max}$ *then the addicted agent chooses rehabilitation and the other agent does not consume the addictive good.*

The first Nash equilibrium leads to an interesting situation in which a non addicted agent consumes like an addicted agent to comply with the social norm of his group. Once again, we have also a situation where we can switch from one equilibrium to the other. Although movements from (1) to (2) or from (4) to (3) are not possible, it is possible to have movements from (1) to (3) or (4) and from (4) to (1) or (2). This means then once again, we can observe cyclical patterns of consumption-rehabilitation-consumption. In this kind of situation, policy aiming at changing the network of friends or changing the behavior of friends may be desirable in a rehabilitation perspective.

6 Conclusion

In this paper we highlight the role of peers in the recurrence of addictive behavior. To do so, we use a simple "forward looking" model with procrastination and introduce peers influence. Results from the "forward looking" framework and the "forward looking" with procrastination framework indicate that any policy intervention that decreases the cost of rehabilitation or the net benefit of consumption may help stoping the addictive behavior. In this case, once the agent rehabilitates there is no recurrence. Given that recurrence is very frequent in addictive behaviors, we suggest a model in which this recurrence is explained by peers influence. The inclusion of peers influence allows for the possibility of multiple Nash equilibria and potential coordination failures. Our results show that while procrastination can explain the decision to postpone rehabilitation, peer influence is essential to explain the cyclical patterns of addiction-rehabilitation-addiction. In such a case the desirable policy intervention to stop the addictive behavior will be different. An intervention on the social network itself may be desirable to make sure that recurrence does not occur. While there is a growing interest in the formation of social networks and homophily (Currarini, Jackson & Pin 2009) in this paper we assume that the network of friends is exogenous to the model. In future work, it may be interesting to endogenize the formation of the agent's network.

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