Dynamic Networks to explore predictors of substance use among patients beginning treatment for Substance Use Disorders
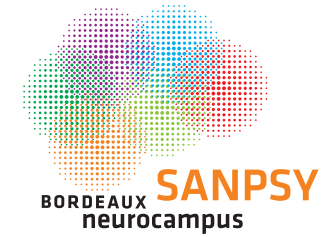
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INTRODUCTION

Addiction/Substance Use Disorder (SUD) is defined as the inability to limit use despite the clearly negative consequences. Addiction is characterized by frequent **relapses** that represent the major challenge for addiction treatment.

Craving is defined as an irrepressible and unvoluntary desire to use the substance /addictive behavior (Auriacombe et al., 2018). Craving is a major predictor of relapse, common to all addictions, and thus considered as a **prime target for addiction treatment**.

Ecological Momentary Assessment (EMA) study previously demonstrated a prospective association between increase in number of substance cues, increase in craving intensity, and higher probability of substance use in the following hours (Fatseas et al., 2015).

CUES → CRAVING → USE

EMA studies have also highlighted the influence of other factors on the induction of craving and substance use/relapse (Serre et al., 2015; Perski et al., 2023), including mood states, self-efficacy, pharmacological treatment, etc. Such factors may interact with each other to lead to relapse (Cleveland, et al. 2023).

Network approach seems particularly relevant to provide valuable insights on the interaction of craving **with other symptoms** in the process of relapse.

OBJECTIVE

Explore the dynamic interrelationships between factors associated with craving and substance use in daily life at beginning of addiction treatment
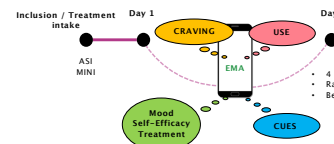
METHODS

Data were extracted from two EMA studies (see Serre et al., 2012, 2015, 2018)

Population
• Patients initiating addiction treatment in outpatient clinics in France
• Alcohol, tobacco, cannabis, opiate or cocaine Use Disorder (DSM-5 criteria)

EMA protocol

Inclusion / Treatment intake — Day 1 — CRAVING — USE — EMA — Day 14
ASI MINI
Mood Self-Efficacy Treatment — CUES
• 4 / day
• Random
• Beep call

ASI: Addiction Severity Index (Denis, et al. 2016)
MINI: Mini International Neuropsychiatric Interview (Sheehan, et al. 1998)
EMA: (see Serre et al. 2012; 2018)

Network Analyses propose that symptoms could be dynamically and causally mutually dependent (Schlechter, et al. 2021), and thereby propose representation of a disorder as a web of mutually influencing symptoms (Borsboom and Cramer 2013).

When applied to EMA data, temporal networks capture dynamic interactions of variables over time and thus enable exploration of possible activation cascade between variables (Epskamp 2020).
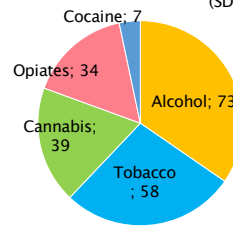
Estimation of the dynamic network

Multilevel vector autoregression (mIVAR; *Epskamp et al., 2018; 2019*, including 6 EMA Variables: Number of Cues, Intensity of Craving, primary substance Use, related factors: Self-Efficacy, Mood (from 1 very sad to 7 very happy), taking a Pharmacological treatment
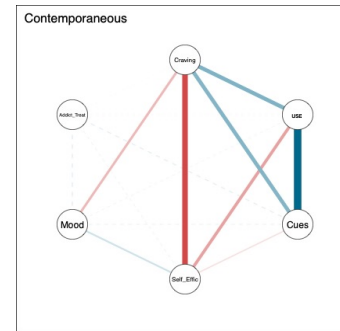• **Contemporaneous network:** within-person associations between the variables within the same assessment, controlled for each other and for the temporal effects.
• **Temporal Network:** average lagged within-person associations between the variables from one point of time (T0) to the next (T1), controlled for each other.
• **Between –subjects network:** associations between the person-means on the variables, given the person-means on the other variables.

RESULTS

n=211   37.0 %   38.2 y.o. (SD=11.1)

EMA Reports
72%
8555 assessments completed
1 *Craving* 7
no 3.6 (SD:2.1) extreme
Primary Substance Use =37.5 %
Nb of Cues = 4.4 (SD 4.3) (Max 22)
1 *Self-Efficacy* 7
Not able to abstain 4.2 (SD:1.9) Totally able
1 *Mood* 7
Very sad 4.5 (SD:1.5) Very happy
Pharmacological Treatment =34.0 %

Cocaine; 7
Opiates; 34
Cannabis; 39
Tobacco; 58
Alcohol; 73

Network models (All SUD pooled) *Positive correlations are in blue, negative correlations are in red. Non-significant correlations are in dashes. The thickness of an edge represents the intensity of the relation, depending on the set of other relations of the network.*


Contemporaneous — Craving, Addict_Treat, USE, Mood, Cues, Self_Effic

Temporal — Craving, Addict_Treat, USE, Mood, Cues, Self_Effic

Between-subjects — Craving, Addict_Treat, USE, Mood, Cues, Self_Effic

Contemporaneous network
At the same assessment
• Substance use associated with number of cues and intensity of craving.
• Self Efficacy inversely correlated with craving intensity and substance use.
• Positive mood associated with less craving and higher self-efficacy.
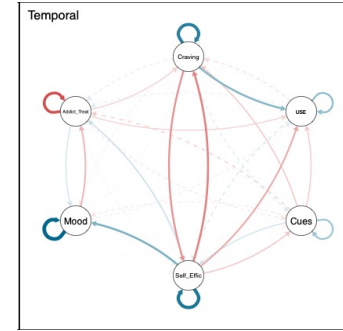
Temporal network
• Unidirectional association between Craving T0 and Substance Use T1 .
• Higher Self-Efficacy T0 associated with less cues, craving and use at T1.
• Feedback loop : higher craving T0 associated with less self-efficacy T1, that in turn is associated with higher craving T2.
• Pharmacological treatment T0 predicted by higher self-efficacy at T-1, and associated with less craving and less substance use at T+1.
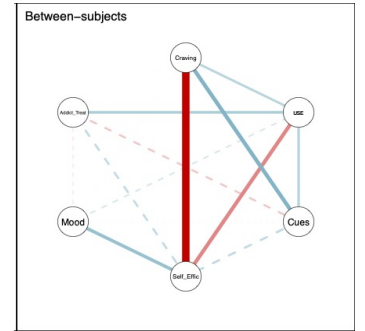
Between-subjects network
• Participants with lower self-efficacy are those with higher overall craving intensity, and respectively (the direction of the relation is not given here)
• Participants who reported the more substance use where also those reporting the highest number of cues, more craving, and more frequent intake of pharmacological treatment.

DISCUSSION

• **Unidirectional association between Craving T0 and Substance Use T1**
➢ Confirmed the major role of craving in substance use (Serre et al., 2015)

• **High inverse correlation between self-efficacy and craving (feedback loop)**
➢ Relevance to focus on self-efficacy to reduce craving / use (Witkiewitz et al., 2022)

• **Negative Mood associated with more craving at the same assessment, but not predictive of craving at the next assessment**
➢ Negative "feelings" induced by craving rather than a triggering factor

• Compared to HLM/ multi-level modelling, dynamic network analyses allow to take into account influences of all network variables, as well as the influence of a variable on itself (AR: auto-regression).

• Limits: not enough data to control for substances specificities (Serre et al., 2018)

• Perspective: examine how different interventions could impact this model over time

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