

## The effectiveness of self-report to tapering off and economic tokens on coffee addiction

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**Abstract:** Excessive caffeine consumption can lead to addiction characterized by functional dependence and withdrawal symptoms when consumption is stopped abruptly. This study aims to determine the effectiveness of behavioral interventions in the form of self-report to tapering off and token economics in reducing the quantity of coffee consumption in individuals with coffee addiction. This research method used a single-subject experimental design on a 28-year-old woman who had a history of coffee addiction for 4 years with a consumption of more than 5 cups per day. The intervention was carried out over three weeks including daily recording and token value-based rewarding. The results showed a significant decrease in average coffee consumption from 3.14 cups in the first week to 1.14 cups in the third week. Participants were able to maintain consumption at a minimum without experiencing symptoms of substance breakdown at the end of the intervention. The combination of self-reporting and token economics has been shown to be effective in facilitating brain neurobiological adaptations and improving participant adherence in gradually reducing caffeine consumption.

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## INTRODUCTION

Coffee has long been known as the most widely consumed psychoactive stimulant in the world. This drink plays a central role in global work and social culture due to its ability to improve alertness, concentration, and cognitive performance (Nehlig, 2010). However, behind its functional benefits, there are significant clinical issues. Caffeine dependence or commonly referred to as coffee addiction. A deep understanding of caffeine's addictive properties, prevalence, and health consequences is crucial in the context of modern public health.

Dependence on coffee is driven by its main content of caffeine which is a psychoactive substance of the methylxanthine group. Caffeine works by becoming an adenosine receptor antagonist in the central nervous system, thereby inhibiting drowsiness signals and triggering the release of stimulants (Meredith et al., 2013). Clinically, coffee addiction is defined as caffeine use disorder. Diagnosis criteria usually include continuous use despite being aware of the presence of physical or psychological problems caused or exacerbated by caffeine, the appearance of tolerance symptoms where a higher dose of caffeine is needed to achieve the desired effect, the occurrence of withdrawal symptoms when consumption is stopped or reduced abruptly (Winata, 2016; Meredith et al., 2013).

Although exact data on the number of coffee addicts who meet clinical criteria are difficult to quantify globally, high levels of caffeine consumption indicate a widespread prevalence of functional dependence. The International Coffee Organization (ICO) reports that the world's coffee consumption is at a very high level, reflecting the world's dependence on caffeine products. Prevalence studies also show that most caffeine consumers experience withdrawal symptoms when they stop consuming. A comprehensive review by Juliano et al. (2012) confirmed that caffeine withdrawal symptoms such as headaches and fatigue indicate that there are withdrawal symptoms experienced by coffee addicts.

Excessive and prolonged consumption of caffeine can cause a series of negative impacts on health such as sleep disorders (Drake et al., 2013; Meiranny & Chabibah, 2022), cardiovascular problems (Saragih & Yonata, 2016), and psychological impacts such as anxiety (Ginting et al., 2022). In addition, coffee addiction causes repeated cycles of use to avoid annoying substance breakout symptoms, such as migraines, severe fatigue, and dysphoria (Juliano et al., 2012). This study aims to determine the effectiveness of behaviors in the form of self-report to tapering off and economic tokens in the face of coffee addiction.

## METHOD

The research design in this study uses a Single Subject Experiment design with a self-report method for gradual reduction (self report to tapering off) and economic tokens. Single-subject experimental design (Single subject experimental design) is a simple research method. The goal is to describe and explain the individual differences specific to each subject. The results are presented in the form of detailed but easy-to-understand quantitative data (Sunanto et al., 2005). self report tapering off is individual reporting used to monitor the progress, challenges, and symptoms experienced during the process of gradual decreasing the dosage of a particular substance.

The participant in this study is a woman with the initials M, 28 years old who has experienced coffee addiction since 4 years ago and usually consumes more than 5 cups of coffee per day. The procedure in this experimental study with a single subject was with the assignment of daily progress recording and periodic reporting (once every 7 days) for three weeks. The success of reducing the frequency and quantity of coffee consumption will be given a score of 2, if they succeed in maintaining the frequency and quantity of coffee consumption as the previous day will be given a value of 1 and if the participant increases the frequency and quantity of coffee consumption from the previous day will be given a value of 0. If the participant manages to collect a score of 7 in a week, the participant is entitled to an award according to the agreement with the researcher, but if it is less than a score of 7, the award will not be given.

The instrument or measuring instrument used in this experimental study with a single subject uses a daily check form that participants fill out after finishing a cup of coffee. The data collected in 3 weeks were then analyzed using simple calculations and diagrams.

*Table 1. Automobile Land Speed Records (GR 5-10)*

Speed (mph)	Driver	Car	Engine	Date
407.447	Craig Breedlove	Spirit of America	GE J47	8/5/63
413.199	Tom Green	Wingfoot Express	WE J46	10/2/64
434.22	Art Arfons	Green Monster	GE J79	10/5/64
536.712	Art Arfons	Green Monster	GE J79	10/27/65
622.407	Gary Gabelich	Blue Flame	Rocket	10/23/70
633.468	Richard Noble	Thrust 2	RR RG 146	10/4/83
763.035	Andy Green	Thrust SSC	RR Spey	10/15/97

## RESULT

From the self-reporting data of the study participants, it is known that on the first day of reporting the participants consumed 6 cups of coffee and dropped to 3 cups of coffee on weekends. In week 2, participants managed to reduce consumption to 1 glass per day. However, in week 3 the participants experienced an increase in consumption, even though until the weekend the participants were able to limit coffee consumption to 1 cup per day. In 3 weeks the participants showed the highest score in week 1 and the lowest in week 3. Participants managed to get an award every week and until the last report the participant did not experience symptoms of substance withdrawal, the symptoms of substance withdrawal actually occurred on the 2nd day where participants tried not to consume coffee at all so that feelings of anxiety, tremors and difficulty concentrating appeared so that participants returned to consuming 2 cups of coffee at once. To make it easier to understand, you can see the table and graph below.

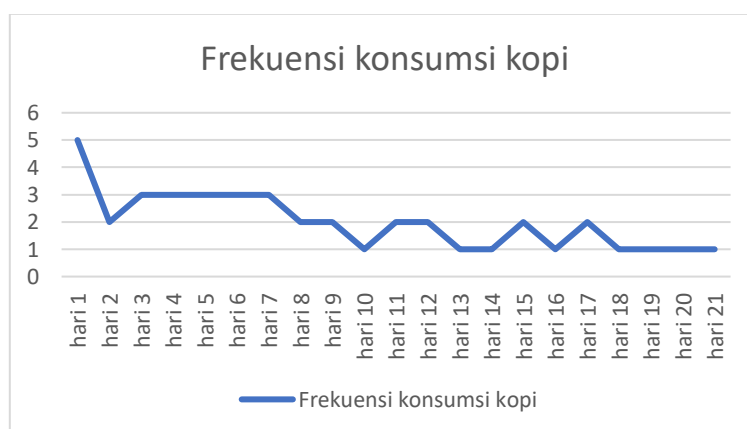
Table 2. Coffee Consumption Self-Reporting Table

Week	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Remarks
1	Frequency	iiii	ii	iii	iii	iii	iii	Day 2 try to quit completely
	Score	2	2	0	1	1	1	
2	Frequency	ii	ii	i	ii	ii	i	Weekly total score: 9
	Score	2	1	2	0	1	2	
3	Frequency	ii	i	ii	i	i	i	Weekly total score: 7
	Score	0	2	0	2	1	1	

Table 3. Coffee Consumption Statistic Table

Statistics	Week 1	Week 2	Week 3
<b>Average (Mean)</b>	3,14	1,57	1,14
<b>Median</b>	3,00	2,00	1,00
<b>Standard Deviation (SD)</b>	0,90	0,53	0,38
<b>Minimum Consumption</b>	2	1	1
<b>Maximum Consumption</b>	5	2	2
<b>Total Token Score</b>	8	9	7

Figure 1. Coffee Consumption Graph



**Statistical Interpretation and Clinical Significance:**

1. Significant Mean Decline:

There was a consistent decrease in average consumption from Week 1 ( $M = 3.14$ ) to Week 3 ( $M = 1.14$ ). This shows that the tapering off intervention effectively reduces the frequency of participants' coffee consumption to the minimum targeted level.

2. Behavioral Stability (Standard Deviation):

The Standard Deviation (SD) value decreased from 0.90 (Week 1) to 0.38 (Week 3). This decrease in SD values indicates that participants' consumption behavior becomes more stable and non-volatile at the end of the intervention period.

3. Visual Analysis of Trends (Level & Trend):

Visually, the chart shows a downward trend with a final level that is much lower than the initial baseline. Despite the small fluctuations in Week 3, participants were able to return to the level of 1 cup per day, demonstrating the effectiveness of the token economy system in maintaining participants' compliance with behavior change targets.

4. Clinical Significance:

The increase in token scores from Week 1 to Week 2 shows a process of adaptation and increased self-accountability through a self-monitoring mechanism. The success of achieving the target of 1 cup without withdrawal at the end of the 3rd week proves that the brain's neurobiological adaptation process has been optimally achieved through a slow dose reduction method.

## DISCUSSION

The results showed that participants experienced caffeine withdrawal syndrome which manifested in the form of psychomotor agitation in the form of anxiety, subtle tremors, and significant decline in cognitive function. Neurobiologically, caffeine acts as an adenosine receptor antagonist; Chronic consumption causes up-regulation or an increase in the number of adenosine receptors in the brain to compensate for caffeine blockade. When consumption is stopped abruptly (cold turkey), the brain experiences an unparalleled surge in adenosine activity, triggering exaggerated, painful, and in certain clinical scenarios can be dangerous, such as severe vascular headaches or disruptions of electrical activity in the brain (Ashton, 1994; Meredith et al., 2013).

The tapering off method has been shown to be superior in mitigating these risks because it facilitates a more stable neurobiological adaptation process. By slowly reducing the dose, the central nervous system is given the opportunity to "down-regulate" or slowly re-normalize the sensitivity and number of neurotransmitter receptors without triggering systemic shock. This gradual reduction minimizes the severity of withdrawal symptoms to a threshold that is tolerable by the individual (Lader & Tylee, 2001).

The success of participants in maintaining the consumption of at least one glass per day without any symptoms of substance breakdown means suggests that tapering off is effective in maintaining brain homeostasis. Clinically, this controlled process not only reduces physical suffering but also strengthens the self-efficacy of the participants. This ultimately improves adherence to the substance cessation program and significantly lowers the risk of relapse compared to the traumatic direct disconnection method (Juliano & Griffiths, 2004; Lader & Tylee, 2001).

The effectiveness of this intervention was strengthened by the consistent use of self-reporting methods by participants. This self-recording process functions as a self-monitoring mechanism that automatically increases self-awareness of consumption patterns and specific triggers of problematic behavior. This awareness is a crucial foundation in behavior modification, as it allows participants to identify high-risk situations and increase personal accountability to preset change targets (Lader & Tylee, 2001; Korotitsch & Nelson-Gray, 1999). By understanding the "when" and "why" of the desire to consume a substance, participants have better cognitive control to redirect the behavior.

In addition to self-awareness, the application of the token economic system in this study is the main driving force in reinforcing the formation of new behaviors. The token economy is a form of behavior modification based on operant conditioning that uses secondary boosters in the form of tokens as instant incentives. In this design, every time a participant successfully displays target behaviors such as restraint or reducing the dose according to the tapering schedule, the participant immediately receives a token in the form of a numerical value. This instant gift is very effective in maintaining motivation because it provides immediate satisfaction for the effort made (Pachas et al., 2017).

The token serves as a bridge reinforcement; although it has no intrinsic value directly, the accumulation of tokens up to the number of seven allows participants to exchange them for a pre-agreed back-up reinforcer. Delayed gratification through token accumulation psychologically trains participants to remain consistent on long-term goals. The use of this measurable and structured incentive system has been shown to significantly increase participants' adherence to the intervention program compared to relying solely on willpower, so that the risk of recurrence can be systematically minimized (Higgins et al., 2011; Pachas et al., 2017).

## **CONCLUSION**

Based on the results of the research and discussion, it can be concluded that behavioral interventions that combine self-report to tapering off methods and token economic systems are effective in overcoming coffee addiction. The tapering off method has been shown to be superior to cold turkey because it allows for neurobiological adaptations to adenosine receptors in the brain, thereby minimizing painful withdrawal symptoms.

In addition, the use of self-reporting significantly increases participants' self-awareness and accountability for their consumption patterns. The support of the token economic system as a positive reinforcement provides strong external motivation for participants to remain compliant with the daily reduction target. Overall, the integration of these two methods is able to reduce the quantity of coffee consumption to a stable minimum limit (1 cup per day) and reduce the risk of recurrence systematically.

## **ETHICS STATEMENT**

This study was conducted in accordance with ethical standards for research involving human participants. Written informed consent was obtained from all participants, and because the participants were minors, additional consent was secured from their parents or legal guardians. Participants were informed about the purpose of the study, the voluntary nature of their participation, their right to withdraw at any time without penalty, and the procedures used to ensure confidentiality.

## **DATA AND CODE AVAILABILITY**

The datasets generated and analyzed during the current study are not publicly available due to ethical considerations and the need to protect participants' confidentiality, as the data contain sensitive personal narratives from minor participants.

## **FUNDING SOURCE**

This research uses self-funding by researchers.

## **CONFLICT OF INTEREST**

The author declares that there are no conflicts of interest related to this study. The research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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