Comparing Time Perception among Morphine-Derived Drugs Addicts and Controls

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Original Article

Abstract

Background: The aim of the present study is to compare time perception among drug addicts and controls.

Methods: 30 drug addicts were selected, and 30 non-addict individuals were selected as the control group. The two groups performed three tests of time reproduction, time estimation, and time discrimination.

Findings: There was a significant difference between the addicts group and the control group regarding the error of time reproduction and time estimation. The addict group in comparison to the control group had a lower under-reproduction and a higher over-reproduction error, and also a lower under-estimation and higher over-estimation error. However, regarding time discrimination, no significant difference was observed between the errors committed by both groups. On the other hand, when showing images of drug consumption tools and normal images with same durations, the normal group believed that the images related to drug consumption tools were shown for a shorter period of time.

Conclusion: Time perception is different between morphine-derived drugs addicts and controls.

Keywords: Time perception; Drug addicts; Time reproduction; Time estimation; Time Discrimination

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Introduction

Heraclitus did not consider time just as a feature of reality but believed that time is an aspect of existence that marks motion and change. Based on this idea, time has been created by men's mind to express the changes of the world by it.[1] In fact, it is possible to talk about the happening of an event in a time or different times when the concept of time has been presumed.[2]

Time perception is an adaptive function which has the ability to anticipate and respond appropriately to the future and imminent events.[3] Many of our behavioral and cognitive features are dependent on this process.[4] For instance, as we grow older we would have a faster perception of time.[5]

Based on the circumstances, a situation could be perceived too fast or too slow. Therefore, it is believed that time perception is dependent on the different situational factors such as the attractiveness of the situation,[6] presence of music,[7] stress level,[8] excitation level[9] and even meditation exercises,[10] and level of attention and distraction.

Recent studies have shown that consumption of the psychedelic substances could have adverse effects on individual's cognitive performance.[11,12] New studies have revealed that high consumption of addictive substances, such as alcohol and opium, could cause cognitive dysfunctions such as impairments in learning, memory, information processing, executive functions, problem solving, and verbal and visual-spatial abilities.[13,14]

Becker and Murphy[15] have indicated that drugs might not increase non-linear changes of the psychophysical function of time perception, but they would increase impatience and prolong the mental time perception (possibly through neuronal dopaminergic adaptation in some regions of the brain like corpus striatum).

Although there has been no study about the effect of morphine-derived drugs on time

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perception, but sporadic researches about the effect of cigarette, marijuana, alcohol, and some other specific and unusual drugs have been conducted. Tinklenberg et al.[16] in a study concluded that in comparison to ethanol and placebo, marijuana would cause a significant under-production of time intervals, which explains the increase in the internal rate of time perception. The initiation of this increase in time perception, during which it seems that physical time passes slower, is accompanied with increased heartbeat and mental effects of the drugs.

Time perception among people who were quitting cigarette was slower than the control group (non-smokers).[17] Sayette et al.[18] mentioned that cigarette craving would affect time perception and insisted that since the time frame for providential acts is < 2 minutes and for retrospective acts is about 6 minutes, these two could not be compared to each other directly. Cigarette craving could make time pass slower, but when it comes to longer processes, verbal estimated time would be decreased.

The study of Wittmann et al.[19] showed that psilocybin substance is the agonist of time perception change and behavioral time control in humans. The agonist is a chemical matter that connects to a cellule's receptors and creates its response and reaction. The agonist mostly imitates the function of a natural substance in the body.[20]

Other studies have shown that impaired time perception and longer understanding of time in smoking quitters causes restlessness and potential of returning to smoking. As an example, dysfunction in the perception of time in smokers who are quitting can be considered as one of the reasons that make them fill more stressed and cause them lack of attention and focus.[17] Ekhtiari et al.[21] showed that disruption in the perception of time is an important factor in risky decision-makings. Hence, study the perception of time among drug addicts may enable us to identify one aspect of a possible relapse and guide us for future researches in addressing these factors. The aim of this study was to compare the perception of time in people addicted to morphine-derived drugs and ordinary people and the effect of drug consumption on the perception of time.

Methods

The present study is a cross-sectional study, with random sampling. From all the referred patients to Drop-In Center (DIC) of Kerman University of Medical Sciences, Iran, 30 individuals were selected randomly and put in the addicted group. The control group was consisted of 30 individuals with no history of drug abuse. For selecting control participants, one of the local companies was chosen and 30 of their employees, who have previously provided "not addicted" confirmation for their company, were selected randomly. There was no significant difference between the demographic data of both groups. The participants of the control group and the addicted group were matched according to their age.

The inclusion criteria for the addicted group were the diagnoses of the Drop-In Center physician and his/her recommendation. This means that all that who were selected for the addicted group were not under any treatment during the study and had no desire to quit drugs. Furthermore, all the participants in the addicted group were consuming morphine-derived drugs (opium, opium sap, and heroin), and nobody used any other kind of drugs simultaneously. Consumption method in those addicts was smoking, injection, and eating.

Then, time reproduction, delay estimation, and time discrimination tests were conducted on both groups, and results were analyzed using descriptive statistics, independent t-test, Mann-Whitney U, and chi-square tests.

For this research, a laptop and a mouse were used to perform tests. The participants only needed to know how to work with keyboard or the mouse and if required received appropriate trainings for using them. The participants were strictly recommended not to use their fingers, tapping or any other means to count time.

To perform this research, computer software which simulated time reproduction, time discrimination, and delay estimation was designed using Embarcadero Delphi 2010 and Microsoft Access 2013.

In this software, three time perception tests were conducted with all of the participants. The results of each test were stored in a separate database with the name of the test. Four tables were separately created to record the demographic characteristics of participants and time perception tests; tests' tables were capable of providing raw scores and calculated scores output

for each test separately. The software produced time intervals randomly.

Time reproduction test

During this test, the period of time interval would not be revealed verbally but would be presented to the participant and then he/she must reproduce the time interval through an act (like pressing down a key on the keyboard).[2] In the present study, time reproduction was evaluated as follows: a lamp would be turned on and off in the middle of the computer screen for variable time intervals (2-24 seconds). Then, the participant was asked to keep the lamp on by pressing down a key on the keyboard for as long as it was shown to him. This test was repeated 7 times for each participant. Individuals older than 5-6 years old usually use counting or other time measurement methods.[22,23] In this kind of time estimation test, the participant would be distracted such that he would not be able to use counting. The distraction factor in the present study was questions that had no emotional meanings and needed no thinking and were appeared besides the lamp; the participant had to read them out loud and answer them.

The variable of time reproduction error is defined as each participant's deviation of the presented time interval (the time period of visual stimulus) during the test. The variable of reproduction error is partitioned into under-reproduction and over-reproduction errors. Under-reproduction error means that the produced interval by the participant was less than the presented interval, and over-reproduction error means that the produced interval by the participant was more than the presented interval. The sum of under-reproduction error and the absolute value of over-reproduction error was the total value of reproduction error.

Delay estimation test

In this test, the participant must estimate the delay before the occurrence of an event, and after the estimated delay has passed, he should show a motor response.[21] For this test usually, a simple software named Time Wall was developed and used. The method of the present study to evaluate estimated delay was in coordination with previous studies.[21] However, our implementation approach was a little different (for the first time Farsi version of Time Wall was used in the present study). In the designed software for this research, when running this part of the test a red circle starts to move from the top of the screen with a certain speed and after passing two-third of the screen it hides behind a dark blue cover and continues its movement. The participant's task was to determine when the circle would reach the other end of the screen, then press a key (space key) at that moment. This test was repeated 10 times for each participant.

The variable of delay estimation error was defined as each participant's deviation from the time when the stimulus really reached the target point. The variable of delay estimation error also could be divided into under-estimation and over-estimation. The sum of under-estimation error and the absolute value of over-estimation error was the total value of delay estimation error.

Time discrimination test

In this test, two visual stimuli were presented to the participant consecutively for a specific period of time, and the examinee task was to determine which of them was displayed for a longer time.[21] The goal of this test was to define the number of recognizable differences between two visual stimuli. The difference between two stimuli was defined in milliseconds.

This test was in coordination with tests used in the previous studies,[2,21,24] and the difference was in the used stimuli for the purpose of the research (i.e., comparing addicts and normal people). The design and structure of the test have made it possible to run it in single assignment form and also dual task template.[2]

In the proposed computer test, typical normal images and images related to drug abuse were presented to the participant as follows and he must have judged which ran longer:

This test was conducted in three stages:

First stage

At the beginning, an image from nature was appeared on the right corner of the screen and disappeared after a specific period of time (not more than 3 seconds) and after 1 second an image about drug abuse or its tools was appeared on the left of the screen for the same period of time and then disappeared. Then, a question was asked from the participant such as "Which image stayed for a longer time?" Under the question three options of "right," "left," and "equal" were

shown and the participant had to choose one of them to go to the next image. This part repeated 13 times.

Second stage

First, a typical image appeared on the right of the screen and disappeared after a specific period of time (2380 milliseconds); then after, a 1-second delay another typical image appeared on the left of the screen and disappeared after a specific time (2000 milliseconds). Like the first stage, the participant must choose which one was shown longer.

Nazari et al.[2] assessed the threshold of time discrimination for two visual stimuli to be 373.06 at 2000 milliseconds level. Hence, in the present study, the difference of target and comparison stimuli (images used in the second and third stages) was considered 380 milliseconds.

Third stage

The final stage was exactly like the second stage only with the difference that the used images were all about drugs consumption. The processes of the second and third stages were also repeated 13 times.

Time discrimination error is the mistake that participant made in differentiating between presented stimuli. In this test, the sum of participant's error at each stage was the time discrimination error of the stage and the sum of the participant's errors of all stages was considered as the total time perception error.

Results

The data of the time reproduction and delay estimation test that is extracted from software's database is shown in table 1.

For time under-reproduction and reproduction variables independent t-test, and for time over-reproduction, the non-parametric equivalent of the independent t-test, i.e., Mann-Whitney U-test, were applied. According to table 2 and considering that the significant level for all three tests was < 0.05, there was a significant difference between the mean of both groups in all three variables of time reproduction. In addition, results of Mann-Whitney U-test for time over-reproduction was 270.00, Z value is -2.78 with the two-tailed significant level of 0.0.

For under-estimation and delay estimation variables independent t-test, and for over-estimation the non-parametric equivalent of the independent t-test, i.e., Mann-Whitney U-test, were applied. According to table 3 and considering that the significant level for all three tests was < 0.05, there was a significant difference between the mean of both groups in all three variables of delay estimation. Moreover, results of Mann-Whitney U-test for delay over-estimation was 108.00, Z value is -5.06 with the two-tailed significant level of 0.0.

Table 1. The results of the time reproduction test and delay estimation test in both groups of addicts and normal (in milliseconds)

Group	Sum of errors	Mean ± SD
Addicts (n = 30)		
Under-reproduction	537389	17913.2 ± 14115.7
Over-reproduction	102169	40305.6 ± 3942.7
Total	639567	21318.9 ± 11951.8
Normal (n = 30)		
Under-reproduction	1019709	33990.3 ± 16208.4
Over-reproduction	47886	1596.2 ± 4287.6
Total	1067595	355865.5 ± 14694.9
Addicts (n = 30)		
Under-estimation	202471	6749 ± 6012.2
Over-estimation	490814	16360.5 ± 14206.7
Total	693285	23109.5 ± 12783.2
Normal (n = 30)		
Under-estimation	355756	11858.5 ± 7824.8
Over-estimation	105618	3520.6 ± 3623.5
Total	461374	15379.1 ± 6211.4

SD: Standard deviation

Table 2. Results of independent t-test for time under-reproduction and time reproduction (the mean of total error)

Variable	Levene's test for equality of variances		t-test for equality of means						
	F	Significant (P)	t	df	Significant (two-tailed)	Mean difference	Standard error difference	95% CI of the difference	
								Lower	Upper
Time reproduction	0.51	0.48	4.13	58	0.0	14267.60	3458.26	7345.15	21190.05
Under-reproduction	0.11	0.74	4.10	58	0.0	16077.03	3924.14	8222.00	23932.06

df: Degree of freedom; CI: Confidence interval

Table 3. Results of independent t-test for under-estimation and delay estimation (the mean of total error)

Variable	Levene's test for equality of variances		t-test for equality of means						
	F	Significant (P)	t	df	Significant (two-tailed)	Mean difference	Standard error difference	95% CI of the difference	
								Lower	Upper
Delay estimation	2.34	0.13	-2.98	58	0.00	-7730.37	2594.82	-12924.47	-2536.27
Under-estimation	1.64	0.20	2.83	58	0.01	5109.50	1801.62	1503.17	8715.83

df: Degree of freedom; CI: Confidence interval

Table 4. Results of chi-square test for the first stage, second stage, and third stage of time discrimination test and the sum of the results of all three stages

Variable	Chi-square value	df	Significance level
Stage 1	0.752	1	0.386
Stage 2	0.358	1	0.550
Stage 3	0.007	1	0.374
Total	0.789	1	0.374

df: Degree of freedom

In the next step, the number of participants' errors was extracted from software's database. Then, the chi-square test was conducted for three parts of time discrimination test separately and also for the total result.

According to table 4 and based on the achieved significance levels, there was no significant difference between both addicted and normal groups regarding the number of errors. Therefore, there was no significant difference between time discrimination error of the addicted group and the normal group.

To evaluate another difference between both groups at the first stage of time discrimination test (comparing images about drug abuse and typical images with equal time periods), the number of cases where the participants of each group under-evaluated the time of presented typical images was extracted from the database. Then chi-square test was conducted on the extracted data. The test results for assessing the number of under-evaluations in images about drug abuse show a chi-square value of 3.932, degree of freedom of 1 and significance level of 0.047.

According to these results, there was a significant difference between the addicted group and the normal group (significance level = 0.047). It means that normal participants have under-evaluated the time of presented images about drug abuse.

Discussion

Results have shown that addicted participants had a significantly lower under-production error compared to the normal participants (almost half), but their over-production error was higher with the same proportion. Therefore, it could be concluded that drug addicts would over-evaluate the presentation time of a stimulus. This result confirms the results of Heishman et al.,[11] Ramaekers et al.,[12] Gonzalez,[13] and Gruber et al.,[14]

which revealed that psychedelic substances have adverse effects on cognitive performances and data processing. Moreover, some studies have reported that drug abusers have a weaker performance compared to the normal group in psychomotor tasks that indicates the low speed of data processing[25] and a disorder in visual-spatial data processing have been observed among drug addicts.[14,26]

The results of delay estimation test showed that addicted participants had less under-estimation error and more over-estimation error. It could be concluded that drug addicts over-estimate the timing of an event. This result also confirms the results of previous studies which indicated that cognitive performance and data processing in addicted participants are different from normal participants.[11,13,14,25,26]

In time discrimination test, no difference was observed between the number of errors in the addicted group and the normal group. The only difference in this part was the difference in understanding the time of drug-related stimuli. In comparing drug-related and typical images with equal time periods, the normal participants under-evaluated the time of presentation of drug-related images. If we assume that drug-related images have negative meanings for normal people, this result confirms the result of Nazari et al.[27] that revealed the effect of excitement on time perception and indicated that words with negative emotional meaning would be assumed shorted than neutral words.

On the other hand, these results are inconsistent with the results of some previous studies. The result of Droit-Volet et al. study[28] showed that the assessed time period for negative emotional faces in comparison to neutral faces was way too much. It seems that over-estimation of negative facial expressions is related to individual differences in negative agitation accountability. Furthermore, encountering furious facial expressions could activate the response system for fear. In fact, by reviewing the evolutionary history, a hypothesis might be presented that strong arousal response threatening stimuli (for example furious facial expressions) could suggest an instant adaptive response for survival. Furious facial expressions have special effects on time perception because they imply attacking, and hence, they are directly related to human's survival.[27]

The study of Noulhiane et al.[29] also revealed that negative sounds would be evaluated to be longer than positive sounds, and this implies that negative stimuli would increase arousal. Based on attentional models of time perception, the mental time period is directly related to the amount of attentional resources dedicated to time processing. If less attentional resources would be dedicated to timing, time estimation would be shorter. In other words, if emotional events would distract attention from time processing, based on attentional models, these kind of events in comparison to neutral events would be evaluated to be shorter than their real time.[28] Furthermore, previous studies have considered drug abuse as the attention's favoritism to drug-related cues.[30-32] Robinson and Berridge[33] also mentioned that the theory of stimulus sensitization would anticipate that the more an individual's brain become sensitive to drugs, the stronger his attention would focus on drug-related stimulus; the result of the present study is in contrast with these results. If drug-related images would cause addicts to pay more attention to them, then they must have shorter time perception for these images. However, most of the previous studies were conducted on quitting participants. In fact, those studies have shown that the attention's favoritism in "under treatment" of drug abusers and people who were quitting cigarette would increase,[34,35] but the present study was conducted on drug addicts with no intention to quit. Therefore, it could be concluded that drug-related images have no emotional meanings for current drug abusers and could be considered neutral to them; the normal people's time perception for these images would be shorter due to their negative meanings for them.

Conclusion

The study indicated that time perception is different between morphine-derived drugs addicts and ordinary people, and opium consumption may affect time perception.

Conflict of Interests

The Authors have no conflict of interest.

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مقایسه ادراک زمان در معتادان به مواد مخدر و افراد عادی

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مقاله پژوهشی

چکیده

مقدمه: هدف از انجام پژوهش حاضر، مقایسه ادراک زمان در معتادان به مواد مخدر مشتق از مورفین و افراد عادی بود.

روش‌ها: ۳۰ نفر از سوء مصرف کنندگان مواد مخدر به عنوان گروه معتادان و ۳۰ نفر افراد بدون وابستگی به مواد به عنوان گروه عادی (بهنجار) با استفاده از روش نمونه‌گیری تصادفی انتخاب شدند. سپس با نرم‌افزار کامپیوتری طراحی شده، سه آزمون بازتولید زمان، تخمین تأخیر و افتراق زمان بر روی نمونه‌های مورد مطالعه انجام شد.

یافته‌ها: بین گروه معتادان و افراد عادی در خطای بازتولید زمان و تخمین تأخیر تفاوت معنی‌داری وجود داشت. گروه معتادان نسبت به گروه بهنجار دچار خطای زیرتولید کمتر و خطای بیش‌تولید بیشتر و به همین ترتیب خطای زیرتخمین کمتر و خطای بیش‌تخمین بیشتری شدند. در آزمون افتراق زمان، تفاوتی در خطای مرتکب شده توسط آزمودنی‌های دو گروه مشاهده نشد، اما در مقایسه تصاویر مربوط به استعمال مواد مخدر و تصاویر عادی با زمان‌های مساوی، افراد عادی مدت زمان مربوط به نمایش عکس‌های استعمال مواد مخدر را کمتر ارزیابی کردند.

نتیجه‌گیری: ادراک زمان در معتادان به مواد مخدر مشتق از مورفین با افراد عادی متفاوت است.

واژگان کلیدی: ادراک زمان؛ معتادان به مواد مخدر؛ بازتولید زمان؛ تخمین زمان؛ افتراق زمان

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