

The 5 Choice Continuous Performance Task: Translation to a Touch-screen Paradigm

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Introduction

The 5 Choice Continuous Performance Task (5CCPT) is a test of attention and reaction time performed in rodents frequently used to test compounds for drug discovery. Traditionally, this test is executed in standard 5-hole operant boxes where the animal has to nose poke at briefly illuminated holes to earn a reward (“Go” trials). However in a small proportion of the trials all holes are illuminated signaling that the animal must refrain from responding in order to earn a reward (“NoGo” trials) [3]. However the 5CCPT has been criticized for the substantial difference in salience between Go and NoGo trials. Here we describe the training process for 3 different variations of this task (Figure 1). First is the “standard” 5CCPT as described by Young (Figure 1a). Next is a version highly similar to the standard 5CCPT, but translated to the touch-screen environment, the 4 choice continuous performance task (4CCPT; figure 1b). Finally, we trained animals to perform a 4CCPT where the Go/NoGo rule is dependent upon a visual discrimination; image “A” (e.g. plane) indicates that the animal should go, whereas image “B” (e.g. spider) means an animal should refrain from going (4CCPT-VD, figure 1c). This final procedural variation should control for differing salencies associated with each trial type.

Materials and Methods

All experiments described in this abstract have been approved by the local Ethical Committee at Janssen Pharmaceutica.

C57BL6/J mice (Janvier, France) were group housed in ventilated cages with water available ad libitum and kept under 12/12h light/dark cycle in a temperature and humidity controlled room. During training and drug studies, the mice were food restricted and maintained at approximately 85% of their free-feeding body weight. A dedicated group of animals was used for each variation of the task.

Operant Chambers

All experiments were performed using the 5-CCPT procedure in five-hole operant chambers with an attached corridor leading to a pellet dispenser. Each of the chambers consisted of an array of five round holes (1.3 cm in diameter) that were arranged horizontally on a curved wall 5 mm above the grid floor and opposite the corridor. At the end of the corridor a food well was attached at floor level. Additionally, a house-light was installed at the ceiling of the main chamber. The whole set-up was located in a sound-attenuating chamber and vented by a fan.

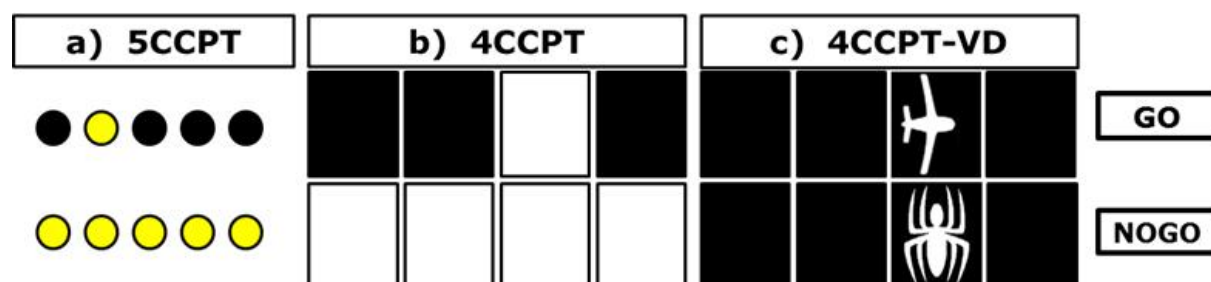


Figure 1. Go and NoGo stimuli for the 3 test variations: 5CCPT, 4CCPT and 4CCPT-VD.

In order to earn a food reward, mice were required to detect a brief light signal (0.5s) presented randomly in one of the five holes and respond at this location within 5s (Go-trials). However in 1/5th of trials, all five holes were illuminated and mice were required to withhold a response for 5s in order to earn a food reward (NoGo-trials).

Touch-screen – 4CCPT

Mice were tested in modified operant chambers of which the wall opposite to the pellet dispenser was replaced by a touch-sensitive computer monitor. In front of this screen was a black metal mask with 4 holes (5 x 7.5cm). Similar to the operant version, white rectangles were shown on the screen in holes of the mask. When a white rectangle was presented (1.5s) randomly in one of the four places on the screen, the mouse had to respond at this location within 5s (Go-trials). However in 1/5th of the trials, four rectangles were shown and mice were required to withhold a response for 5s in order to earn a food reward (NoGo trials).

Touch-screen – 4CCPT-VD

In this variant, one of two pictures is presented upon the screen for every trial (spider or plane). When picture A was presented (1.5s) randomly in one of the four places on the screen the mouse had to respond at this location within 5s (Go-trials). Again, in 1/5th of the trials, picture B was presented and mice were required to withhold a response for 5s (NoGo trials). Four response locations were used in the touch-screen procedure for practical purposes. The ability to discriminate visual stimuli is highly dependent upon the size of the stimuli [1] and these stimuli had previously been validated using a visual discrimination procedure. Smaller images would have dictated the correction of unique stimuli not currently being used in any of our tests. Therefore we choose to instead use fewer locations. To help make the critical comparison between the translated touch-screen version (4CCPT) and the version based upon the visual discrimination, we decided to use only 4 stimuli for this version as well.

Incorrect responses of either type, as well as omissions (Go-trials), resulted in de-activation of the house light and a short delay prior to the start of the next trial. Mice were tested for a total of 120 trials. Accuracies, omissions, and response latencies were measured.

Results

Animals were initially trained to associate a tone and a light in the food well with a reward. Afterwards animals were trained to respond to a stimulus (light on hole or image on a screen) to earn a reward. As soon as the animals reached a high level of performance NoGo trials were introduced. At this point pictures were introduced also in the 4CCPT-VD test. Initially the stimulus duration was set at 20 seconds. However this was decreased in a stepwise fashion every time the mice reached an accuracy of at least 70%. Animals acquired the different task variants at approximately equal rates until the stimulus duration was lowered to 1.5 seconds. We discovered that further decreasing of the stimulus duration only results in a decrease in performance in the touch-screen versions, although we were able to further reduce the stimulus duration to 0.5 seconds in the 5CCPT with minimal effect on accuracy measures.

Conclusion

We proved that it is possible to setup a touch-screen version of the 5-choice continuous performance task. Nevertheless the animals need a longer stimulus duration time, 1.5s versus 0.5s, to reach an acceptable performance. Animals trained in the 5 CCPT test reach an accuracy of 79% on the Go-trials and 86% on the NoGo trials while 4CCPT and 4CCPT-VD have a higher Go accuracy (95% and 96%) but a lower NoGo accuracy (62% and 78%). There's also a very clear difference in Response Bias (RI) between the different tests. The animals trained in both touch-screen tests have a bias towards responding compared to the operant test where the animals have a bias towards not responding despite their high level of accuracy.

Table 1. Average performance during last week of training. 5CCPT with a stimulus duration of 0.5 seconds, 4CCPT and 4CCPT-VD with a stimulus duration of 1.5 seconds.

	GO accuracy	NOGO accuracy	Omissions	RI
4CCPT (n=12)	95 %	62 %	24 %	0.21
4CCPT-VD (n=19)	96 %	78 %	30 %	0.26
5 CCPT (n=11)	79 %	86 %	14 %	-0.30

Keywords. Behavior, attention, animal model, validation, 5-choice, touch-screen

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