

Introduction to DMDX

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1 DMDX¹

DMDX is an experimental presentation control and RT-measurement software, designed and supported by Jonathan and Ken Forster, Department of Psychology, University of Arizona. It is restricted to Windows, but free, flexible, powerful, reliable, and supported by a very active mailing list.

1.1 Getting Started

- official website and tips for getting started:
 - <http://www.u.arizona.edu/~jforster/dmdx.htm>
 - http://www.uta.edu/faculty/jeffreyw/psyling/language-processing/DMDX%20tutorial_revised.pdf
- mailing list: DMDX-request@psy1.psych.arizona.edu.
- Reference: <http://www.u.arizona.edu/~kforster/dmdx/DMDX%20Timing.pdf>

1.2 DMDX and TimeDX

- DMDX - presents stimuli and records responses with ms-accuracy, based on a script that determines basic parameters of the experiment (e.g. presentation times, screen colour, input devices) and the order and way in which items are displayed. Experiments can involve simple text displays or the script can call up additional media files with auditory or visual stimuli.
- Before DMDX can run, TimeDX is needed to set and check software and hardware features of the PC/laptop (Millisecond Timer, Refresh rate, Select Video Mode, Time Video Mode) and additional input devices (e.g. USB-game pad)
<http://psy1.psych.arizona.edu/~jforster/dmdx/help/timedxhooverview.htm>
[http://dionysus.psych.wisc.edu/MediaWiki/index.php/Downloading_and_configuring_DMDX_and_TimeDX_\(Rebecca_Gloria\)](http://dionysus.psych.wisc.edu/MediaWiki/index.php/Downloading_and_configuring_DMDX_and_TimeDX_(Rebecca_Gloria))

1.3 TimeDX

After downloading DMDX and TimeDX, click on the TimeDX icon and follow these steps:

- Close all other programmes and disable your wireless connection to avoid interruptions from pop-up messages and interference (NOTE: do the same while running an experiment using DMDX).
- The first time, TimeDX is running, you need to select the video/sound driver you want to work with (not the default).
- Check that the **Millisecond Timer** is working: and try restarting the machine if it is not working
Menu > Basic Tests > Millisecond Timer Test. Start this test and let it run for a while, then press Stop to finish it. This test provides you with information about timing accuracy -- most callback latencies should be around 1 ms, with a standard deviation of no more than .3 ms.

¹ This introduction is based on information from the DMDX website, the DMDX-mailing list, and web-materials by Nan Jiang, Matt Davis, John Curtin, Mike Ford, Jeffrey Witzel.

<http://psy1.psych.arizona.edu/~jforster/dmdx/help/timedxhtiming.htm>

- In order to set and check the video mode you will use, you need to do the following:

Menu > Basic Tests > Select **Video Mode**

Select a video mode that is supported by your PCI card and click on Do Test. This should show the text "TimeDx" on your screen. Press Escape, return to the Video Mode menu and select "Done". Make sure you write down the video mode information as you can later use it for your DMDX script. For instance when you see "1024x768 (60Hz) 16 bit (65536 colour) RGB", you would include "<vm 1024, 768, 768, 16, 60>" in your DMDX script for your experiment. For help with video modes, see:

<http://psy1.psych.arizona.edu/~jforster/dmdx/help/timedxhvideomodes.htm>

- Determine your refresh rate, the time it takes to redraw the screen from top to bottom, using your chosen video mode. This ms-interval can be used in the script. For instance, if your refresh rate is 16.ms, that is one "tick" and you can later specify your presentation times using these ticks as units instead of ms. Select the basic test for the **Refresh Rate**. If the picture of crossing lines does not stabilize, you may need to play around a bit trying out different combinations of tick-boxes on the menu (to take into account properties of your drivers, etc.).

<http://psy1.psych.arizona.edu/~jforster/dmdx/help/timedxhrefreshrate.htm>

- Go to the Advanced Tests and click on **Time Video Mode** and select the Vertical Retrace Sync Test. After performing the test, you **MUST** save the value to the registry by pressing the button: "Saved Last Used Values in Registry", otherwise you will get error messages about the video mode when you try to run your script in DMDX. If you get too many errors and time-outs, try this again after a restart. If problems persist, we found it useful to go back to the Refresh rate menu and try out different options there.

<http://psy1.psych.arizona.edu/~jforster/dmdx/help/timedxhverticalretracesyncthread.htm>

- Make sure all the devices you later want to use in your experiment are connected and use the **Input test** from the basic test menu to test your input devices (keyboard, USG-game pad, mouse, etc.) are working. The names of the devices and their buttons will be required in your script, Note that the numbers that are printed on game pad buttons are not necessarily the numbers that are used internally to address the buttons. So it is crucial that you determine the numbers of the buttons using the Input test.

When you start the test, the top box shows you a list of devices that are currently connected to the computer. When you select one by clicking on it and hit the Test button, you see the numbers or names of the buttons (you can use either in the script, for non-English names, use the numbers with the "#"). You can then find out which of the buttons/keys on your devices have which numbers/names by pressing them and watching what gets highlighted on the screen.

<http://psy1.psych.arizona.edu/~jforster/dmdx/help/timedxhinput.htm>

<http://psy1.psych.arizona.edu/~jforster/dmdx/help/dmdxhinput.htm>

1.4 Running an Existing Experiment in DMDX

- Close all other programmes and disable your wireless connection to avoid interruptions from pop-up messages and interference.
- Click on the DMDX icon on your desktop.
- Use "browse" to locate the script, which has to be a file in rtf-format (see below).

- After selecting the appropriate file choose the “Syntax Check” button to check for any possible mistakes in the file.
- Use “Run” to start the experiment
- When the experiment is finished, press “Escape” (Esc) to exit the window and save the result file.

1.5 Reasons for Potential Problems

- The video mode in the script has not been properly set up in TimeDX, with values saved in the registry (Fixing this requires Time Video Mode). You have either not run TimeDX before or you have not saved the values for your video mode after the Time Video Mode test.
- The script tries to call up input devices that are not connected. They need to be plugged in.
- The name of your device or the names of keys/buttons that you use in the script are not the same as the ones you are shown in the Input test.
- The script tries to call up media files that are not in the experiment folder.
- Your script does not have the proper format: it is not an rtf-file, line delimiters like ";" or brackets are missing, or there are other formal errors (see below).

1.6 Files Required for a DMDX experiment

DMDX allows for sound, video and picture files to be presented along with text at particular time windows. Video, sound and picture files are **Stimulus files**. All lines of text that represented to the participants, along with further details about their presentation and RT-measurements, are part of another file, namely the **Item file**. This file also calls up the wav-files, mov-files, etc. that are used as stimulus files. Both stimulus and item files should be placed in the same folder before running the experiments.

<http://psy1.psych.arizona.edu/~jforster/dmdx/help/dmdxhitemfiles.htm>

The Item file consists of all the information regarding the text presented to the participant (bold, italics, etc) along with the *instructions* that DMDX will have to follow when running the experiment. These “instructions” or “commands” will inform the software about what stimuli needs to be presented at what time etc. The item file determines (amongst other things):

- which stimuli should be presented to participants,
- for how long the stimuli should be presented,
- when the measurement for response times should start,
- what should be considered as a correct or incorrect response.

Item files are **rtf** (rich text format) files. The Item file can be created in programmes like Microsoft Word or Open Office and then saved as **rtf**. The information available in the Item file is divided into two sets of lines: (i) header lines and (ii) item lines.

1.7 Header Lines

A header line is the starting point for every Item file. It sets the parameters for the experiment. As can be seen in Figure 1 and Figure 2, headers always start with <ep> ("extended parameters") and end with <eop>("end of parameters"), while the order of the other parameters is flexible, as long as each individual parameters is enclosed in angle brackets and parameters are separated by blanks. Table 1 provides an overview of common parameters (see the DMDX webpage for additional information).

```
<ep> <cr> <fd 30 <d 59> <t 1500> <id keyboard> <mnr "+Left Arrow">
<mpr "+Right Arrow"><dbc 210210210> <dfs 36> <dwc 0> <vm
1024,768,768,16,60> <nfb> <eop>
```

Figure 1: An Example Header Line for a Visual Lexical Decision Experiment using Keyboard Inputs

```
<ep><azk> <cr> <fd 17> <d 169> <t 2500> <vm 1024, 768, 768, 16, 60>
<id keyboard> <id "Logitech RumblePad 2 USB"> <MapPositiveResponse
+Button 4> <MapNegativeResponse +Button 5> <dbc 255255255> <dwc 0>
<nfb> </ep>
```

Figure 2: An Example Header Line for an Auditory Lexical Decision Experiment using Game Pad Inputs

Header Line	Name	Function
<cr>	Continuous Running	Without this, DMDX would pause after each item and wait for the participant to request the next item (as in a self-paced reading task).
<fd>	Default Frame Duration	This tells DMDX for how long each “frame” (stimulus word or picture) should be displayed. FDs are measured in ticks and the length of a tick for a given set-up can be determined using the Refresh Rate test in TimeDX (see above). For instance, for a video card running at a refresh rate of 60Hz, on a tick will last approximately 16.67ms.
<d>	Delay	The delay is measured (in ticks) from end of one item to the start of the next. This delay needs to be long enough to allow DMDX to load all stimuli for next item.
<t>	Time-out measured in milliseconds	This tells DMDX how long to wait for participants to make a response. If no response has been made before this time then the program moves on to the next item (this could affect the timing of the item)
<req>	Enable Request input	This allows DMDX to show stimuli on the screen after the participant has requested that through pressing a button (e.g. in a self-paced reading task).
<N>	Number of items	This informs DMDX about the exact number of items in the file
<Azk>	Output data to an ASCII text file	This ensures that the results will be exported as ASCII text.
<id>	Identify Device	This provides DMDX with information about the devices from which the responses should be recorded, e.g. keyboard, mouse, or USB-game pad. The correct name of the device can be found using the Input test in TimeDX.
<nfb>	No feedback	This tells DMDX that no feedback should be given to participants’ responses.

<dbc>	Default Background	<p>The default background is white. If you want to change the color, you need to use specific codes, e.g:</p> <ul style="list-style-type: none"> • 255000000 for red • 000255000 for green • 255255255 for white (all colors) • 000000000 for black (no colors) • 210210210 for a light gray <p>Colours are defined in RGB format by three numbers from 0-255 representing the brightness of each gun.</p>
<dwc>	Default Writing Color	<p>The default writing color is black. If you want to change the color, you need to use specific codes, see above.</p>
<dfs>	Default Font Size	<p>The font size you use to introduce your text will be the default one. In case that you need to add text in Bold or Italics you should do that when typing the text in the individual items lines.</p>
<In>	Set Text display now	<p>In case that text displayed on the screen goes further than one line, this will specify where it should be presented.</p>
<vm>	Video Mode	<p>This parameter refers to the video mode that was tested using TimeDX before the experiment. Video Modes are specified using five numbers, e.g. <vm 1024, 768, 768, 16, 60>:</p> <ul style="list-style-type: none"> • 1024 number of pixels horizontally, • 768 number of pixels vertically • 768 number of scan lines • 16 number of bits of color • 60 refresh rate (available on XP only) <p>One can also use <vm desktop> to specify that the desktop video mode will be used. .TimeDX provides you with the option to select the Desktop mode of the respective machine for the test and then save the resulting values in the registry. Using <vm desktop> can be useful as one can avoid changing the vm-parameter in scripts if one works with a set of computers that have been set up for different desktop video modes.</p>

Table 1: DMDX Header Parameters

If you are using a game pad to record responses, you need to specify which button should be used for a “Yes-Positive” response and which as a “No-negative” response, using the <MapPositiveResonse...>- and <MapNegativeResonse...>-parameters respectively (see Figure 2). If you are using the keyboard as an input device, the RIGHT and LEFT SHIFT buttons are mapped to yes/no respectively. If you want to specify other buttons, you can map them using the same procedure as for an external input device. The use of parameters for different input devices and their buttons or keys is illustrated in Figure 1 and Figure 2.

1.8 Item Lines

An Item line holds all the information related to the items, referring to the actual conditions tested. Information regarding the particular stimulus, such as sound files, display times for particular items, etc. are included here (see Figure 3 and Figure 4).

```
0 "Press SPACEBAR to start";
+11 * "elefant" /;
+12 * "flower" /;
-23 * "fonkel" /;
+14 * "cap" /;
0 "The END! Thank you for your participation";
```

Figure 3: Example Item Lines for a Visual Lexical Decision Experiment

```
0 ;
11 / <wav 2> "Introshort" / ;

+1 / <fd 120> <bmp> "blank" / <bmp> "F38" / <wav 2> "F38" / <fd 180>
<bmp> "F38" / <wav 2> "Q_F38" / * <t 10000> <bmp> "F38" <cr>;
+2 / <fd 120> <bmp> "blank" / <bmp> "15a-c" / <wav 2> "15a" / <fd
180> <bmp> "15a-c" / <wav 2> "Q_15" / * <t 10000> <bmp> "15a-c" <cr>;
-3 / <fd 120> <bmp> "blank" / <bmp> "F14" / <wav 2> "F14" / <fd 180>
<bmp> "F14" / <wav 2> "Q_F14" / * <t 10000> <bmp> "F14" <cr>;

12 / <wav 2> "end" ;
```

Figure 4: Example Lines for a Visual World Experiment

Similar to the header line, item lines have particular parameters that they should follow. These parameters need to be set again by the user. See Table 2 below for more information regarding the parameters used and see the DMDX webpage for additional information)

Name/Symbol	Function
+/-	Informs DMDX whether the “yes” (+) or “no” (-) response is the correct answer for that item
^	Indicates that the correct response is no response
=	Indicates that any response could be correct
+/- 0098	The number after the +/- is the item number. Each item should have a unique number since the output will refer to these numbers.
*	This marks the point at which DMDX should start measuring RTs.
%	If an item needs to be presented for a time that differs to the standard frame duration set in the header line, % can be used to specify the new duration. You can add “ms” before % if you want to count the time duration in milliseconds rather than in ticks.
/	This marks the end of a frame. This is when the screen is cleared
;	This marks the end of an Item. At this point DMDX will either wait for a response or a time-out and then move on to the next item.
“#####”	To display more than one word at a time simply add another frame to each item line.
0 “Press SPACEBAR to start”;	Before individual item lines you should add this starter line
0 “The END! Thank you for taking part.”;	After the last item line, you should add this end line
“!”	Use this if you want to add any comments to your item file since lines starting with this symbol will be ignored by DMDX
<wav 2>	This keyword should be introduced before every wav file since it informs DMDX that a speech file should be played.

Table 2: DMDX Item Line Components

For more example files, see

http://www.u.arizona.edu/~kforster/dmdx/examples_of_scripts.htm

http://experimentalfieldlinguistics.files.wordpress.com/2013/09/fieldappropriate_experimental_methods_2014.pdf

<ep> <cr> <fd 30 <d 59> <t 1500> <id keyboard> <mnr "+Left Arrow"> <mpr "+Right Arrow"><dbc 210210210> <dfs 36> <dwc 0> <vm 1024,768,768,16,60> <nfb> <eop>

! Item number AB;

! A=condition (1=word, 2=non-word);

! B=Trial number;

0 "Press SPACEBAR to start";

+11 * "*rabies*" /;

-22 * "*brantly*" /;

-23 * "*skelve*" /;

+14 * "*jump*" /;

0 "The END! Thank you for your participation";

Figure 5: Script for a Lexical Decision Experiment