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Search Google Scholar for peer-reviewed, published research using the Inquisit Wisconsin Card Sorting Test (WCST). Berg, E. A. (1948). A simple objective technique for measuring flexibility in thinking. Journal of General Psychology, 39, 15-22. Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtiss, G. (1993). Wisconsin Card Sorting Test manual: Revised and expanded. Odessa: Psychological Assessment Resources. Berman, K. F., Ostrem, J. L., Randolph, C., Gold, J., Goldberg, T. E., Coppola, R., Carson, R. E., Herscovitch, P., Weinberger, D. R. (1995). Physiological activation of a cortical network during performance of the Wisconsin Card Sorting Test: a positron emission tomography study. Neuropsychologia, 33, 1027-1046. Milner, B. (2003). Effect of Different Brain Lesions on Card Sorting. Archives of Neurology, 9, 90–100. Greve, K. W., Stickle, T. R., Love, J., Bianchini, K. J., Stanford, M. S. (2005). Latent structure of the Wisconsin Card Sorting Test: a confirmatory factor analytic study. Archives of Clinical Neuropsychology, 20, 355-364. Rossi, A., Daneluzzo, E., Tomassini, A., Struglia, F., Cavallaro, R., Smeraldi, E., Stratta, P. (2006). The effect of verbalization strategy on Wisconsin Card Sorting Test performance in schizophrenic patients receiving classical or atypical antipsychotics. BMC Psychiatry, 6, 3. Miles, Stephanie, Howlett, Caitlin A, Berryman, Carolyn, Nedeljkovic, Maja, Moseley, G Lorimer, & Phillipou, Andrea. (2021). Considerations for using the Wisconsin Card Sorting Test to assess cognitive flexibility. Behavior Research Methods, Behavior research methods, 2021-03-22. The Wisconsin Card Sorting Test has a long tradition in the field of psychology and today it is even being conducted online. This task is a powerful way to measure cognitive and flexibility reasoning, still proving popular today amongst cognitive psychologists and researchers. Read on to learn more about the in's and out's of the Wisconsin card sorting task, its history, how it can be conducted online, and the powerful research findings that it can unveil!History of the Wisconsin Card Sorting TaskSo, why does the Wisconsin Card Sorting Test (WCST) have 'Wisconsin' in its name? It has nothing to do with the visual stimuli and everything to do with its origin story. The WCST dates back to 1948 and the University of Wisconsin. Researcher Esta Berg wrote the paper A Simple Objective Technique for Measuring Flexibility in Thinking and therein lies the beginning of the WCST. Based on experiments that were conducted at the University of Wisconsin Primate Laboratory, rhesus monkeys showed a response to positive and negative stimuli shifts where the stimulus object reward was the only clue that the problem was changed. This suggested a possible technique that could be transferred to humans for measuring abstraction and shift sets as a means of quantitatively measuring reasoning and thinking. From this, the WCST was inspired. Notably, in this paper, Berg thanked researchers David Grant and Harry Harlow (who is famous for this attachment theory).About the Wisconsin Card Sorting TestSo what is the Wisconsin card sorting task all about? In the WCST, participants are presented with several cards. On the card, there are different visual stimuli determined by three criteria, the:symbol (ie. shape),number of the shapes, andthe color.In the image below, you can see a card that represents:A squareThe number 2The color blueDuring the task, the participant has a target card that defines the 'rule' they are looking for. Below that card, there are three more cards with variations in the criteria (i.e. representing different possibilities in shape, number, and color). The participant has to guess what the target criteria is in order to get a 'Correct' feedback response. In the example below, you can see a sample trial for the Wisconsin Sorting Card Test. The participant sees the target card and has to pick from 3 options.If the rule is color, then option 1 is correctIf the rule is shape, then option 2 is correctIf the rule is number, then option 3 is correctThe only clue on what the rule is comes from the feedback that is presented upon the feedback that is presented upon choice selection.Cognitive FunctionsResearch assessing cognitive functions using the WCST states its relevance for the following:Executive functionTask switchingCognitive reasoningCognitive flexibilityWorking memoryProblem solving abilityResponse maintenanceIn addition to its relevance for studying the above cognitive functions, some advantages of using the Wisconsin card sorting task include it not being language-based, thus instructions are straightforward and the level of instructions needed can be minimal (Gomez-de-Regil, 2020).Measurement and Data from the WCSTWhen conducting the Wisconsin card sort task, certain indices and measurements are gathered that are specific to the test. These include, but are not limited to:Conceptual level responses: The number of three or more correct trials which occurred consecutively.Perseverative responses: The number of trials which involve perseverative behavior. Perseverative response or behavior is defined as when the participant matches a card based on the same criteria used in the previous trial, regardless of the response being right or not.Perseverative errors: The number of wrong trials which involve perseverative behaviorNon-perseverative errors: The number of incorrect trials which did not involve perseverative behaviorFrom the above, perseverative errors and responses are most commonly used to indicate cognitive flexibility. Since there is a wide body of research using the WCST, it is also possible to see the following indicators being used (Chiu & Lee, 2019):Total errors: The total number of trials where the answer was wrongTotal correct: The total number of trials where the answer was correctCategories: The number of categories where a specific rule appliesThe number of categories completed: The total number of categories that were completed successfully; sometimes referred to as 'categories achieved'Number of trials to complete the first category: The number of trials it took to complete the first category successfullyFailure to maintain set: The number of wrong trials which occurred after five or more consecutively correct trials.Learning to learn: The participant's average change in conceptual efficiency across successive categoriesGaze and/or head movement: In the case where eye tracking and/or head tracking are included, physiological measurements on gaze and/or head position can also be gathered.As with any measure, it is important to control for potential confounds that can influence the results of the test, including the WCST. Possible confounds to consider include age- and educational-related effects as they have been reported to affect the results with younger participants performing better (Miranda et al., 2019). With regards to age, it is relevant to note here that the WCST is one of the most commonly used paradigms for measuring executive function in children. When administering the Wisconsin card sorting test, it is used in children who are 5 years old at up. Even though, from a developmental perspective, children that are younger can switch from one rule to another. Tests for young children with fewer rules or dimensions (such as only shape and color) and one switch do exist, such as the Dimensional Change Card Sort (Czapka & Festman, 2021).Also worth mentioning is the growing level of interest in determining as to whether the WCST is a culture-free test, meaning that culture can possibly confound results, with some researchers highlighting the importance of developing certain versions to account for this variation. Another point to consider is the method of administration, with some researchers showing that there are no differences between manual and computerized/online versions of the Wisconsin card sort task in healthy populations while other disagree and go the further step of saying there may be even greater differences when administering this paradigm to clinical populations (Aran Filippetti, Krumm, & Raimondi, 2019). Furthermore, it is also common to see researchers control for variables such as intelligence as it is an important predictor of executive functions, socioeconomic status, and lexicon size (Czapka & Festman, 2021).WCST Scores: UsesAs study goals can vary, below are the most common uses of the scores obtained from the Wisconsin card sort task:Description of the participants' clinical profile: to quantify cognitive processes of a specific clinical profile.Comparison of clinical profiles within groups: to quantify and compare the cognitive processes of a specific clinical profile, such as comparing between patients with mild traumatic brain injury (TBI) with moderate-to-severe TBI patients.Treatment outcome: where the main focus is the effect of treatment and intervention and the Wisconsin sorting card test is used as a measure to quantify changes in cognitive processing.Inclusion criterion: by using the certain scores of the WCST, certain participants can be included or excluded in a study.Performing the Wisconsin Card Sorting Test OnlineA lot of neuropsychological tests are being performed online nowadays, including the WCST.Using the Wisconsin Card Sort online for your study comes with many advantages, including:Being easy to buildQuickly shareable with participantsAdvanced data gathering, like reaction time and gaze from our webcam-based eye tracking.Advancing the body of research available and developing the fieldTry out or import the online WCST for your next study. Below is a preview of how implementing the WCST-64 in Labvanced would look like:Example of WCST-64 Data Recorded in LabvancedIn the image below, you can see what some of the data recorded from a Labvanced-based WCST-64 study looks like. The columns represent variable values like: the number of correct responses, the current rule, whether the rule changed, the reaction time, and characteristics of the selected card, as well the target card, such as its color, number, shape and number.Findings and Experiments Using the Wisconsin Card Sorting TaskThe WCST is used in both clinical and healthy populations to assess cognitive processes. There is a large body of research that makes use of this classic experimental paradigm. Some examples of experiments and findings can be found below. Additionally to the areas discussed below, the Wisconsin card sorting test has been administered to study disorders such as Attention Deficit/Hyperactivity Disorder (ADHD), fetal alcohol syndrome, epilepsy, hydrocephalus, autism spectrum disorders, learning disorders, prefrontal damage, post traumatic stress disorder, and more.Stroke PatientsThe WCST is one of the most commonly used measures for evaluating stroke patients' executive functions. In a study by Chiu, Wu, Hung, & Tseng, published in 2017, the validity of the Wisconsin card sort task was assessed in patients with strokes by placing a special focus on the ecological, discriminative, and convergent validities of the test while measuring daily living activities. The researchers found that even though the WCST has poor ecological validity for patients with stroke, the discriminative and convergent validities were both found to be acceptable. From the indices of the task, the authors found that the "number of completed categories" and the "total number correct" measures were the best to use when determining the stroke patients' levels of living independently.In 2019, Faustino, Oliveira, and Lopes investigated the diagnostic precision of the WCST as an instrument for measuring executive functioning in participants with substance abuse disorders. Specifically they looked at the specificity and sensitivity of this neuropsychological instrument when comparing the participants with substance abuse disorder to healthy controls from the general population. The sample was made up of 587 participants and the substance abuse participants consisted of three groups: opioid use disorder under treatment in a therapeutic community, opioid use disorder under treatment with harm reduction and methadone maintenance, and alcohol use disorder in a therapeutic community. The researchers found that the WCST results between groups were significantly different, demonstrating the test's strong discriminant validity.SchizophreniaIn schizophrenic patients, impaired executive functions are a prominent cognitive problem. An estimated 68-85% of schizophrenics have been found to have impaired executive functions. Thus, the WCST is a common measure for assessing executive functions in this clinical population. Researchers and clinicians need to conduct tests from time to time in order to track treatment progress, but also to develop effective treatment plans that can improve executive functions. Due to the need of conducting such cognitive tests multiple times, the test-retest reliability is an important discussion topic for administering the WCST in schizophrenic patients. A study by Chiu & Lee pointed out that the Wisconsin card sorting test has acceptable test-retest reliability within their sample study. They found that the three indices have excellent test-retest reliability (i.e, "Number of Categories Completed," "Total Number Correct," and "Conceptual Level Responses") and that two more indices have good test-retest reliability (ie., "Perseverative Responses" and "Perseverative Errors"). While the authors addressed limitations in their study, such findings show the importance of considering test-retest reliability for repeated measures assessments like the Wisconsin card sort task.TBIA review has shown that the WCST is a common measure for assessing executive functions in different TBI populations. After the occurrence of the TBI, the average time for patients with the condition in case studies ranged from 4 years to 62 years while in studies with multiple participants, the average time after occurrence ranged from 6 weeks to 23.5 years. Randomized controlled trials also make use of the Wisconsin sorting card test when assessing the impact of a medical treatment. Clinical trials that assessed TBI patients using the WCST for determining intervention effectiveness focused on treatments like: sertraline, growth hormone therapy, or rehabilitation programs like neuro-feedback, CogSmart, or vocational problem-solving. Furthermore, with regards to the scores, the most common reported indices in TBI patients are: perseverative errors, categories completed, and perseverative responses. The review also includes findings comparing mean scores of WCST perseverative errors and categories in studies with TBI Patients. For example, patients with mild TBI average 22.10 perseverative errors, compared to 16.34 perseverative errors in a group of healthy controls, versus 41.7 perseverative errors in a group of mild-to-severe TBI patients (Gomez-de-Regil, 2020).OCDBohon, Weinbach & Lock used a computerized version of the WCST together with functional magnetic resonance (fMRI) to measure neural responses and cognitive performance of female adolescents with Obsessive-Compulsive Disorder (OCD). The results showed that the OCD group had a significantly greater amount of perseverative errors compared to healthy controls. With regards to neural correlates, greater activity was found in the OCD group in the inferior frontal gyrus, the right front pole, and the middle frontal gyrus when performing the Wisconsin card sort task, compared to a control matching task. This activity was not observed in healthy controls performing the WCST. The right inferior frontal gyrus is involved in inhibition. The researchers noted that the greater activity in this region in the OCD group, despite their unsuccessful performance, could suggest a greater effort to inhibit responses.MultilingualismThe Wisconsin card sorting task can also be used in healthy populations to study cognitive skills. In a study by Czapka and Festman, the relationship between multilingualism and cognition was assessed utilizing the WCST. Since there is evidence that bilingualism can improve executive functions, the researchers wanted to see to what extent this applies to multilingual (bi- and trilingual) children by comparing their performance on the WCST and comparing it to normal monolingual controls. The researchers found that multilingual participants had significantly lower monitoring (defined as the pre-switch reaction time) scores and concluded that this supports the theory that multilingualism impacts processing speed in monitoring during the WCST.ConclusionThe WCST is a widely known and recognized assessment tool for measuring cognitive flexibility and reasoning. While some authors point out that there may be some misunderstanding as to how to score the WCST (Miles et al., 2021) and how it is used in a clinical setting, other researchers find that the WCST is more than reliable for clinical practice and testing (Kopp, Lange, & Steinke, 2021). Furthermore, while the main cognitive function that the WCST assesses is cognitive function, given that it is a complex task, there are other processes that are bound to be involved, such as learning, memory, and attention (Miles et al., 2021). The body of research around the Wisconsin card sort task is growing to this day as it is widely used in many applications, such as studying clinical conditions like OCD or schizophrenia, but also in healthy participants to study the effects of speaking multiple languages. Overall, the test is powerful and the availability of Wisconsin Card Sort online shows its relevance for research in the 21st century.ReferencesArán Filippetti, V., Krumm, G. L., & Raimondi, W. (2020). Computerized versus manual versions of the Wisconsin Card Sorting Test: Implications with typically developing and ADHD children. Applied Neuropsychology: Child, 9(3), 230-245.Berg, E. A. (1948). A simple objective technique for measuring flexibility in thinking. The Journal of general psychology, 39(1), 15-22.Bohon, C., Weinbach, N., & Lock, J. (2020). 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A simple objective technique for measuring flexibility in thinking. Journal of Experimental Psychology, 39, 15-22. Grant, D. A., & Berg, E. (1948). A behavioral analysis of degree of reinforcement and ease of shifting to new responses in Weigl-type card-sorting problem. Journal of Experimental Psychology, 38, 404-411. Milner, B. (1963). Effects of different brain lesions on card sorting: The role of the frontal lobes. Archives of Neurology, 9, 100-110. Nyhus, E. & Barcelo, F. (2009). The Wisconsin Card Sorting Test and the cognitive asesment of prefrontal executive functions: A critical update. Brain and Cognition, 71, 437-451.

_____ WISCONSIN CARDSORT TEST (WCST) _____ Script Author: Katja Borchert, Ph.D. (katjab@millisecond.com) for Millisecond Software, LLC Date: 07-24-2012 last updated: 02-17-2022 by K. Borchert (katjab@millisecond.com) for Millisecond Software, LLC Script Copyright © 02-17-2022 Millisecond Software Millisecond Software thanks Stephanie Miles and Caitlin Howlett for ample support in continuously improving the Inquisit WCST script!

_____ BACKGROUND INFO _____ This script implements a computerized version of the Wisconsin Cardsort Test (WCST); a test of cognitive flexibility upon (unannounced) rule changes. The WCST implemented in this script is based in part on Grant & Berg (1948)* as well as Heaton et al (1993) and is played with 2 decks of cards (64 cards in each deck). Reference for WCST: Grant, D.A. & Berg. E.A. (1948). A behavioral analysis of degree of reinforcement and ease of shifting to new responses in a Weigl-type card sorting problem. Journal of Experimental Psychology, 38, 404-411. Heaton, R., Chelune, G., Talley, J., Kay, G., & Curtiss, G. Wisconsin Card Sorting Test Manual—Revised and Expanded 1993. Lutz, FL: Psychological Assessment Resources Inc Additional WCST information to read: Miles, S., Howlett, C.A., Berryman, C. et al. Considerations for using the Wisconsin Card Sorting Test to assess cognitive flexibility. Behav Res (2021). NOTE: 1) To play the short version (WCST-64) with only one deck of cards, change parameters.cstotaltrials from 128 to 64 under section EDITABLE PARAMETERS. ****DISCLAIMER**** This script* runs Millisecond's best effort attempt to code perserverative responses according to the guidelines outlined by Heaton et al (1993). Coding may, however, still differ from published definitions or contain errors. Please check the definitions of the coded variables used in this script under the data glossary. If in doubt, manually score the raw responses. *Note: previous Inquisit WCST scripts may have used a different definition of Perserverative Responses _____ TASK DESCRIPTION _____ Participants are asked to sort cards into four different "categories". No instructions are given in regard to the categorization rules. The four different categories are - one red triangle - two green stars - three yellow crosses - four blue circles. The cards to sort into these piles have similar designs and vary in color (4), shape (4), and number (4).

_____ DURATION _____ the default set-up of the script takes appr. 5 minutes to complete

_____ DATA FILE INFORMATION _____ The default data stored in the data files are: (1) Raw data file: 'wcst_raw*.iqdat' (a separate file for each participant) build: The specific Inquisit version used (the 'build') that was run computer.platform: the platform the script was run on (win/mac/ios/android) date, time: date and time script was run subject, group: with the current subject/groupnumber session: with the current session id blockcode, blocknum: the name and number of the current block (built-in Inquisit variable) trialcode, trialnum: the name and number of the currently recorded trial (built-in Inquisit variable) Note: trialnum is a built-in Inquisit variable; it counts all trials run; even those that do not store data to the data file such as feedback trials. Thus, trialnum may not reflect the number of main trials run per block. phase: 'testing' 'scoring' - 'duplicates' the selected raw data and adds scoring of perserverative response count_ColorBlocks: the number of color blocks started count_FormBlocks: the number of number blocks started count_NumberBlocks: the number of form blocks started colortrialcount/numbertrialcount/formtrialcount: sum up the trials run by category trialCount: counts the total trials run category : 1 = color; 2 = form; 3 = number stimulusitem.1: the presented target card stimulusitem.2- stimulusitem.5 the selection of cards to choose from (stay the same throughout the task) response: the participant's response (card selection) latency: the response latency in ms; measured from onset of target card ResponseCategory: => records features that the selected card (response) and the test card have in common CFN (color, form, number); CF (color; form); CN (color, number); FN (form, number) C (color); F (form); N (number); O (other) ambiguous: 0 = responseCategory "C", "F", "N" are unambiguous 1 = any other response correct: the correctness of the response (1 = correct; 0 = otherwise) correctstreak: counts consecutive correct responses (if an error is made, it's reset back to 0) totalcorrect: sums up all the correct responses across the task totalerror: sums up all the incorrect responses across the task Additional data columns used to code perseverative responses (the algorithm to code perseverative responses runs AFTER all raw data have been collected as some responses will be coded as perseverative responses only in retrospect). All the following columns are filled under block.rawdatascoring/trial.scoring //duplicates raw data for scoring purposes scoring_deckCount: tracks the number of decks run scoring_trialCount: tracks the number of total trials run scoring_trialCountPerCategory: tracks the number of trials run per category scoring_categoryCount: tracks the number of categories run scoring_category: tracks the category run: 1 = C; 2 = F; 3 = N scoring_card: tracks the specific card presented during the trial scoring_response: tracks the selected response card scoring_respCategories: tracks the response category; e.g. CN => the response falls into the color/number categories scoring_ACC: tracks the accuracy of the response: 1 = correct (aka respCategories contained the current category); 0 = error scoring_correctstreak: tracks the number of consecutive correct responses scoring_ambiguousResponse: tracks the ambiguity of the response: 1 = ambiguous response (falls into one than more than one response category); 0 = unambiguous response scoring_perseverativeResponse: tracks perseverative responses: 1 = perseverative response (pResponse); 0 = not scored as a pResponse* (see below for how pResponses are scored in this script) scoring_pResponsePrinciple: tracks the pResponse-principle that were (likely) currently in effect for scoring pResponses scoring_perseverativeError: 1 = response was incorrect AND coded as perserverative 0 = otherwise (2) Summary data file: 'WCST_summary*.iqdat' (a separate file for each participant) !!!!Important Note: the definitions of the summary variables in this script might differ from the originals. inquisit.version: Inquisit version run computer.platform: the platform the script was run on (win/mac/ios/android) startDate: date script was run startTime: time script was started subjectid: assigned subject id number groupid: assigned group id number sessionid: assigned session id number elapsedTime: time it took to run script (in ms); measured from onset to offset of script completed: 0 = script was not completed (prematurely aborted); 1 = script was completed (all conditions run) Important Note: the definitions of the summary variables in this script might differ from the originals. cstotaltrials Maximum Number of trials (default = 128 => 2 decks x 64 cards) cstotalblocks: Maximum Number each category is tested (default = 2) correctstreakthreshold: Number of consecutive correct responses before a rule change (default = 10) setmaintainthreshold: Number of consecutive correct responses after which an incorrect response is scored as a "Failure to maintain Set" (default = 5) showdeckinfo: if set to "true" information about the deck (e.g. 1 of 2) and card number (e.g. 7 of 64) are displayed on the screen for the participant to see (default: false (0)) count_ColorBlocks: the number of color blocks started count_FormBlocks: the number of form blocks started count_NumberBlocks: the number of number blocks started colortrialcount/formtrialcount/numbertrialcount: sum up the trials run by category trialCount: counts the total trials run totalcorrect: number of correct responses across the task number_Errors: number of total errors (all incorrect responses) made Percent_Errors: percentage of incorrect responses (relative to all responses) Note: See Definition of 'PerserverativeResponse' below under explanation of implemented algorithm number_pResponses: number of perseverative responses made Percent_pResponses: percentage of Perserverative Responses (relative to all responses) number_pErrors: number of perseverative errors (Note: responses have to be incorrect AND scored as perseverative) Percent_pErrors: percentage of Perserverative Errors (relative to all responses) number_OtherErrors: number of 'Other' error responses Percent_OtherErrors: percentage of Other error responses (relative to all responses) completedcategories number of categories (color, form, number) successfully completed (min = 0, max = 6) Sum_FailureMaintainSet keeps a total of the number of times a participants selects an incorrect card after a correctstreak that was >= setmaintainthreshold trialscompletefirstcategory keeps track of how many trials a participant needed to complete the first category after having maintained a correct streak of 5 or higher (default) percenterror_C1/.../percenterror N2: percent errors in the first color category ....percent errors in the second number category (etc.) Diff_C1F1 etc.: Difference scores of percent errors in adjacent categories (e.g. Diff_C1F1 = percenterrors in first color category - percenterrors in first form category) LearningToLearn: the mean of the obtained difference scores _____ EXPERIMENTAL SET-UP _____ (1) Cards: - Participants receive the equivalent of 2 decks of cards. Each deck contains 64 different cards. - Researchers can set whether to display the deck/card info for the participants on the screen under section EDITABLE PARAMETERS - the cards of each deck are randomized without replacement (see list.selectcard for more detail) (2) Order of Categorization Rules: Color -> Form -> Number - Maximal 2 of each category - Rules change after 10 consecutive correct responses for a category (default, can be changed under VALUES) (3) End of Task: (a) reached the maximum number of cards: - Maximum Number of Trials/Cards: 2 (decks) x 64 (cards) => 128 cards (b) successfully completed 2 sequences of the color->form->number sequence - Minimum number of trials/Cards = 10 (correct trials per block) * 6 (max number of blocks)=> 60 cards (4) Instructions - Instructions can easily be changed under EDITABLE INSTRUCTIONS - Text Stimuli can be easily changed under EDITABLE STIMULI (5) Dependent Variables/Scores: - latency of response - accuracy of response - total number of correct responses/total number of errors - Total Number/Percentage of perseverative responses - total number of trials - number of trials needed to complete first category - categories completed (Max = 6) - Number of "Failures to Maintain Set" across Experiment - "Learning to Learn" measures: error difference scores (of percentages) from adjacent categories IMPORTANT NOTE: please be aware that the definitions of the summary variables in this script might differ from the originals as well as from other published ones. _____ ALGORITHM TO SCORE PERSERVERATIVE RESPONSES (see Heaton et al, 1993)

_____ Perserverative Responses: "persistence to respond according to a stimulus characteristic that is currently incorrect (although perseverative responses can also be correct because of the potential for ambiguous responses and the sandwich rule)" First (Color) Block: - the first unambiguous error sets the pResponse-Principle BUT is not scored as a pResponse in itself (Note: only C/F/N responses considered for setting the pResponse-Principle) - the next time an unambiguous error of the pResponse-Principle is made, it's scored as a pResponse Subsequent Blocks: - the previous correct category becomes automatically the pResponse-Principle and all subsequent unambiguous errors of the pResponse-Principle are scored as a pResponse. Sandwich pResponses: all ambiguous responses (can also be scored as correct!) that contain the pResponse-Principle made inbetween two unambiguous pResponses (=sandwiched btw. two pResponses) are also scored as pResponses. Example: Begin of Form Block: Form category is correct, Color category is pResponse-Principle CF => correct response (contains F) C (incorrect response) => unambiguous C error: pResponse CF (correct response) => sandwiched btween two pResponses AND contains C => all responses btw. 2 pResponses contain C => all are scored as pResponses as well (even if the response is scored as correct) CN (incorrect response) => sandwiched btween two pResponses AND contains C => all responses btw. 2 pResponses contain C => all are scored as pResponses as well CFN (correct response)=> sandwich btween two pResponses AND contains C => all responses btw. 2 pResponses contain C => all are scored as pResponses as well C => second unambiguous C error: pResponse (the script retrospectively scores the sandwich responses as pResponses) !IMPORTANT: pResponse-Principle changes According to Heaton et al (1993) the pResponse-Principle of a block can change. This can happen if a participant makes three unambiguous errors of the NON-pResponse-Principle (in this script: these responses have to be made UInterrupted by unambiguous errors of the pResponse Principle but can be interrupted by correct responses or responses of the O-category) and ALL AMBIGUOUS responses inbetween these three unambiguous error responses contain the NON-pResponse-Principle). In these cases the pResponse-principle changes and all responses that contain the new pResponse-principle from (and including) the SECOND to the THIRD unambiguous error are scored as a pResponse. Example: 1. Block (color is the correct category) 1) N (first unambiguous incorrect response) => sets the pResponse-principle (N) (but not a pResponse!) 2) NC => 'correct' (not sandwiched inbetween pResponses) 3) N (incorrect) => first actual pResponse 4) F (incorrect) => first unambiguous error of the F-category 5) CN (correct) => ambiguous C/N response (scorred as 'correct') 6) F (incorrect) => second unambiguous error of the F-category (after trial7 will turn into the first unambiguous error of the F-category) 7) F (incorrect) => third unambiguous error of the F-category => HOWEVER, not all responses btw, the third (trial7) and first F-error (trial4) contain F => therefore trial7 unambiguous F-error will be re-classified as the second F-error => after trial8 this error will be retrospectively scored as the first pResponse of the F category 8) F (incorrect) => scored as the NEW third unambiguous F-error => all responses up to trial 6 contain F => F is the new pResponse-principle => all trials btw. trial 8 and trial7 (including trial 7) are retrospectively scored as pResponses 9) N (incorrect) => 'simple' error (not a pResponse as the pResponse-Principle has changed) _____ INSTRUCTIONS _____ provided by Millisecond Software - can be edited under section Editable Instructions _____ EDITABLE CODE _____ check below for (relatively) easily editable parameters, stimuli, instructions etc. Keep in mind that you can use this script as a template and therefore always "mess" with the entire code to further customize your experiment. The parameters you can change are: cstotaltrials: Maximum Number of trials (default = 128 => 2 decks x 64 cards) cstotalblocks: Maximum Number each category is tested (default = 2) correctstreakthreshold: Number of consecutive correct responses before a rule change (default = 10) setmaintainthreshold: Number of consecutive correct responses after which an incorrect response is scored as a "Failure to maintain Set" (default = 5) showdeckinfo: if set to " true" information about the deck (e.g. 1 of 2) and card number (e.g. 7 of 64) are displayed on the screen for the participant to see (default: false) /picsize: size of cards determined by canvas height percentage (default:30%) In this task, you need to match a card to one of four cards based on its shape, color, or number.Example: Please look at the following cards.Based on the instructions, select the card among the four above that matches the condition of the card below.Explanation:If the task asks you to match by color, select the first card; if by shape, select the second card; if by number, select the fourth card. The rules will change periodically, so you need to adjust your matching strategy based on feedback. There are 60 trials, and after each trial, you will receive feedback to help you understand the current rule. Berg, E.A. (1948). Journal of Experimental Psychology, 38, 404-411. A simple objective technique for measuring flexibility in thinking. Journal of Experimental Psychology, 39, 15-22. Grant, D. A., & Berg, E. (1948). A behavioral analysis of degree of reinforcement and ease of shifting to new responses in Weigl-type card-sorting problem. Journal of Experimental Psychology, 38, 404-411. Milner, B. (1963). Effects of different brain lesions on card sorting: The role of the frontal lobes. Archives of Neurology, 9, 100-110. Nyhus, E. & Barcelo, F. (2009). The Wisconsin Card Sorting Test and the cognitive asesment of prefrontal executive functions: A critical update. Brain and Cognition, 71, 437-451. 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The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. The world-leading free platform for online psychological research and information PsyToolkit is a free-to-use toolkit for demonstrating, programming, and running cognitive-psychological experiments and surveys, including personality tests. PsyToolkit is frequently used for academic studies, for student projects, and for teaching cognitive and personality psychology. PsyToolkit is the only totally free website offering running programmable online psychological experiments and surveys. Because many thousands of other students and academics around the world are using it. Because it supports many different languages in the online surveys PsyToolkit is well documented with many examples you can copy for your own project. You can program your experiment, collect data, and analyze all with just this one website. You can run complex psychological surveys, and use from more than 100 surveys in the survey library. If you also use cognitive psychological experiments, you can simply copy them from the experiment library. PsyToolkit is fast and reliable (with multiple servers in professional data centers in the US and Europe). PsyToolkit is reliably managed by a Professor Stoet. Julian Wehlmann MSc Psychology in Sport and Exercise, German Sport University: It is very intuitive and even I with little programming knowledge can learn easily and quickly. I recently told my professor that I could imagine using this for my future doctorate. A really good website! Tuomas Eerola Professor of Music Cogntion, Durham University (UK): One of my PhD students recommended PsyToolkit for our online studies four years ago and now we have done over ten studies with it. These have ranged from priming (with reaction time responses) studies to generic surveys to customised setups where we pioneered new paradigms such as visually guided continuous ratings. In our review of all online platforms (Eerola et al., 2021), PsyToolkit offers best value and flexibility, and it also provides robust solutions to issues of quality control and security (GDPR etc.). The documentation is easy to use and comprehensive. Michał Folwarczny PhD in Marketing, Department of Business Administration, Reykjavik University: I started using PsyToolkit at the beginning of my PhD. At that time, I had no programming knowledge. However, after watching a tutorial on YouTube, I designed my first experiment and ran it online after only two or three hours. PsyToolkit has always been very intuitive, easy to learn, and most importantly, free. It is also very easy to share study scripts on repositories like OSF; therefore, PsyToolkit contributes to open science. Click here to enter (or register for) the free web-based environment for designing/running online experiments and questionnaires. This is great for working from home and doing online data collection around the world! Click here to learn about common cognitive psychological concepts and experiments, and how to setup research projects in PsyToolkit Click here to go to the very extensive online documentation and find everything you need for writing your own PsyToolkit scripts. Click here to go to the answers to Frequently Asked Questions (FAQ). This contains answers to questions that are being asked over and over. Click here to enter the collection of common experiments in the area of experimental cognitive psychology, such as the Simon and Stroop task. Click here to enter the collection of scales that can be used in the survey presenter. Click here to get in touch with the PsyToolkit developer. Click here to learn how you can support PsyToolkit. Your company or institution can become an official PsyToolkit sponsor. Please contact us if you would like this. Click here to learn more about the copyright and your rights and responsibilities when working with PsyToolkit. PsyToolkit is on various social media. Click the links below to go there. If you have a Facebook account, you can click the like button below. For the latest updates and news For tutorials and indepth help The (WCST) is a psychological examination commonly employed to evaluate executive function, cognitive flexibility, and problem-solving skills. It was initially created by psychologists at the University of Wisconsin in the 1940s, and it has since grown to be one of the most popular neuropsychological tests.During the test, participants are given cards with one of four printed abstract symbols. The cards are distinct in terms of color, shape, and quantity. Following an implied sorting rule, the player arranges the cards into several piles. The participant must learn the new rule through trial and error as the sorting rule evolves.The test aims to gauge the participant's flexibility in switching focus between tasks and their capacity to adjust to changing rules. Additionally, it estimates how well they can control previously ingrained responses and take in input.The Wisconsin Card Sorting Test has been used in various settings, such as clinical psychology, neuropsychology, and academic study. It is frequently used to evaluate people who have neurological problems, brain traumas, and psychiatric conditions like schizophrenia and autism. The test is also employed in academic research on the neural and cognitive processes that underlie cognitive flexibility and problem-solving skills.Click here to view on YouTubeWisconsin Card Sorting Test (WCST) is a psychological test frequently used to evaluate cognitive adaptability, executive function, and problem-solving skills. The test is organized into several steps, which are described below:IntroductionAfter explaining its objectives and methodology, the test administrator seeks the participant's consent for taking the test.Sorting PhaseOne of four abstract symbols is printed on each of the 128 cards the participant is given. The participant is instructed to separate the cards into various piles per an implied sorting rule. The participant must learn the new rule through trial and error as the sorting rule evolves.Feedback PhaseThe test administrator gives feedback on whether the participant's sorting was right or wrong after the participant has sorted several cards. The purpose of the input is to aid the participant in learning the new sorting rule.Rule Change PhaseThe sorting rule is abruptly modified after the participant sorts a predetermined number of cards. The initial phase's feedback is no longer relevant, and the participant must learn the new rule by trial and error.Continuation PhaseDifferent sorting criteria and feedback are used in each iteration of the feedback and sorting processes. The participant needs to develop the ability to adjust to the shifting rules and use the feedback to enhance their sorting abilities.ScoringThe number of correct sorts, perseverative errors (i.e., continuing to sort by a previously accurate but no longer relevant rule), and non-perseverative errors are among the various metrics used by the test administrator to evaluate a participant's performance (i.e., failing to switch to a new rule when necessary).Overall, the Wisconsin Card Sorting Test is a challenging and intricate test that calls for flexibility in thinking, problem-solving skills, and learning aptitudes. It is frequently used to evaluate people with mental problems, neurological disorders, and brain injuries and to research the neural and cognitive processes that underlie cognitive flexibility and problem-solving skills.The Wisconsin Card Sorting Test (WCST) is frequently used to evaluate executive function and flexibility of cognition, two critical components of cognitive functioning in daily life. Therefore, the test is commonly used in clinical and research settings to evaluate individuals who may have cognitive impairments due to neurological or psychiatric conditions, such as: The Wisconsin Card Sorting Task can be utilized in studies to examine the neurological and cognitive processes underlying cognitive flexibility and problem-solving skills. It can also be used as a pre-employment tool or in educational contexts to evaluate people's cognitive capacities and the likelihood of success in particular work roles or academic programs.The Wisconsin Card Sorting Test (WCST) is a specialized neuropsychological test that trained professionals typically administer. Here is a list of professionals who may use the Wisconsin Card Sorting Test (WCST) in their practice:Clinical PsychologistsThese specialists are skilled in diagnosing and treating mental health conditions, and they may administer the WCST to measure patients' cognitive functioning.NeuropsychologistsThese experts focus on diagnosing and treating cognitive and behavioral issues caused by br