Cognitive Aging Study (Mex-Cog)

Linked to

The Mexican Health and Aging Study (MHAS)

Methodological Document

Version 3.0

August 2020

The Study on Cognitive Aging Linked to MHAS (Mex-Cog) is funded by the National Institutes of Health / National Institute on Aging (NIA/NIH R01AG051158). The data files and documentation are for public use and are available at www.MHAS.org.

Suggested citation for this document:
Mex-Cog (2020), Study on Cognitive Aging Linked to MHAS: Methodological Document, Version 2, January 2020. Retrieved from www.MHAS.org on (date).

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I. Introduction

The Mexican Health and Aging Study (MHAS; ENASEM for its acronym in Spanish) started in 2001 with the aim of having a data source that would allow studying the aging process in Mexico using a broad socioeconomic perspective (Wong et al. 2017[1]). The study was designed to be highly comparable with other studies, particularly the Health and Retirement Study (HRS) in the United States. The MHAS survey instrument contains a section through which the cognitive status of the target population is evaulated with a short and easy to administer battery, which offers information about the global cognitive status and several cognitive domains.

In order to have a more complete protocol that evaluates in greater depth the cognitive status of older adults and that allows comparability across different studies on aging and health, in 2016 the National Institute on Aging of the National Institutes of Health in the United States (NIA/NIH), funded the implementation of a harmonized protocol for cognitive aging (HCAP). A similar protocol would be applied using subsamples of the national samples of the sister studies of the HRS in different countries. Several studies were selected for this harmonized application, initially in countries such as the United States (HRS) and Mexico (MHAS). Other countries have also been included, such as China (CHARLS), India (LASI), England (ELSA), and South Africa (HAALSI), among others.

The general objective of the Mex-Cog study is to measure the prevalence of dementia and cognitive deterioration in Mexico through analysis methods and strategies harmonized with other countries to maximize the comparability of the data. It was designed by a group of experts from different institutions in Mexico under the direction of Dr. Rebeca Wong of the University of Texas Medical Branch (UTMB), principal investigator of MHAS, and under the coordination of Dr. David Weir, principal investigator of the HRS study. In all phases of the Mex-Cog, Dr. Silvia Mejía of the Colegio de la Frontera Norte participated. In different phases, researchers from the

[1] Wong R, Michaels-Obregon A, Palloni A. Cohort Profile: The Mexican Health and Aging Study (MHAS). Int J Epidemiol. 2017 Apr 1;46(2):e2. PMID: 25626437.

National Institute of Geriatrics (Dr. Luis Miguel Gutiérrez, Dr. Carmen Garcia Peña, Dr. Oscar Rosas), (Dr. Adrián Martínez), National Institute of Public Health (Dr. Belem Trejo and MS. Laura Rosario Mendoza), and National Institute of Neurology (Dr. Ana Luisa Sosa), also participated.

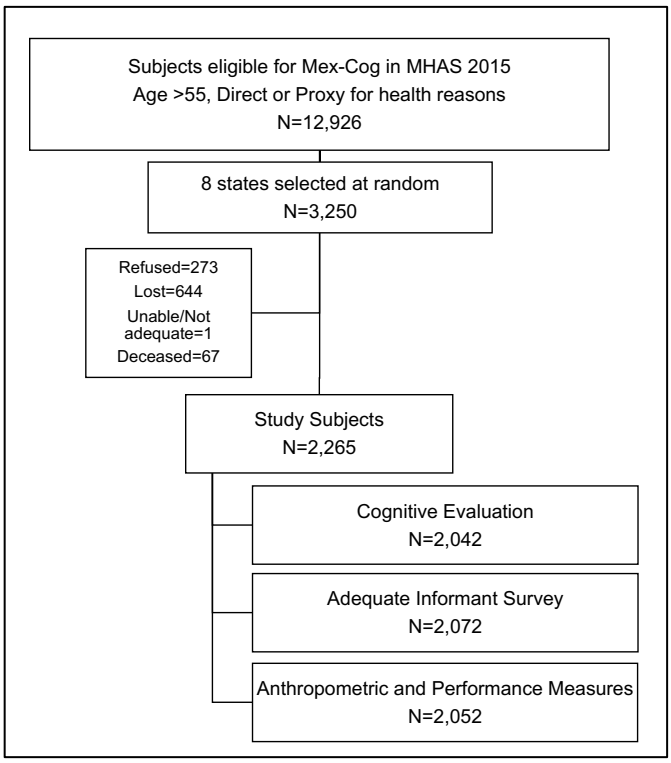
II. Protocol of Mex-Cog

A. Sample Selection

The Mex-Cog 2016 sample was selected using the MHAS wave 4 (2015) as sampling frame. The latter survey was conducted in October to December of 2015, as a follow-up of a sample with national and urban-rural representation of adults aged 50 and older, distributed over all 32 states of Mexico. From the MHAS sample, the criteria for eligibility for Mex-Cog were: first, aged 55 and older in MHAS 2015; and second, having completed a direct interview or a proxy interview for health reasons in the MHAS 2015. To select the sub-sample, and because the Mex-Cog 2016 included collection of anthropometrics and performance measures, first only 8 of the 32 states were selected using stratified sampling procedures. This allowed the fieldwork to be organized in a few states, maximizing the quality control of the measures and minimizing costs. The 8 states were then selected to represent the national population using strata of states according to the following criteria: socioeconomic (percent urban, rural, number of residents who are former migrants to the U.S.) and health exposures (percent with obesity, diabetes, mine industry, and pottery industry). These criteria cover the variety of socioeconomic and health exposures associated with cognitive function in old age. Once the 8 states were selected, all the MHAS 2015 subjects who were eligible in each state were included as the sample for Mex-Cog 2016.

The total Mex-Cog target sample included 3,250 individuals. Interviews were completed for 2,265 subjects representing a response rate of 69.7 percent. See Figure 1 for the distribution of cases according to the type of interviews completed. Of this total, there were 193 cases for which only the cognitive assessment was obtained, and 223 for which only the informant interview was obtained.

Figure 1. Flowchart of the Mex-Cog Sample



B. Conceptual Design and Study Content

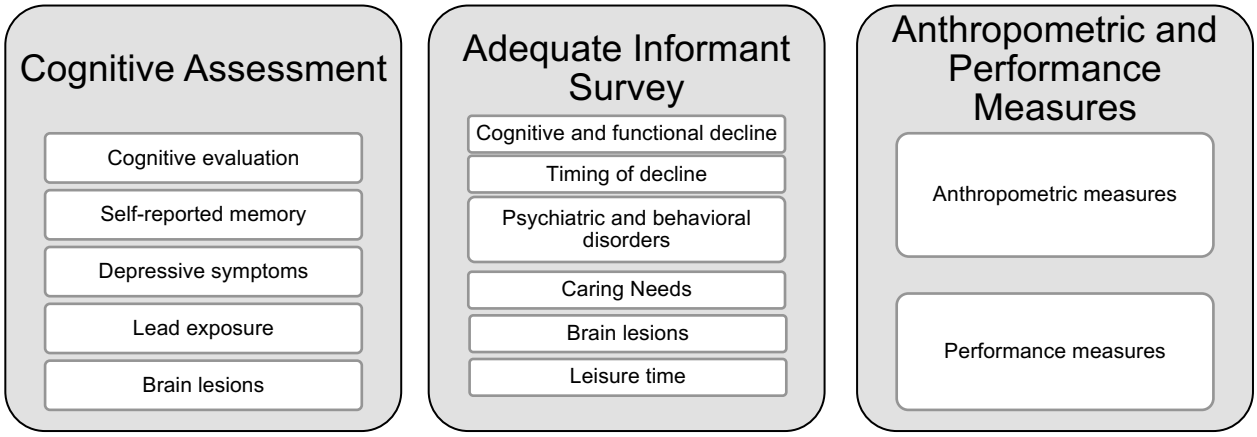
The Mex-Cog contains three parts: Cognitive Assesment, Adequate Informant Survey, and Anthropometric and Performance Measures (see Figure 2).

1. Cognitive evaluation for the study subject.

The evaluation includes a series of tasks to measure the cognitive status of the study subject and self-report questions about memory, depressive symptoms, exposure to lead and history of skull trauma. The evaluation battery begins with a modified version of the Mini-Mental State Examination (MMSE) of 28 points, adapted from the version proposed by Reyes de Beamen et al. (2004[2]). These adapted tasks are represeted by questions 1 to 19 of the cognitive instrument. Subsequently, other adapted tasks are applied for the evaluation of memory, attention, constructional praxies and executive function corresponding to questions 20 to 43 of the instrument.

[2] Reyes de Beaman S, Beaman PE, Garcia-Peña C, Villa MA, Heres J, Córdova A, Jagger C. Validation of a Modified Version of the Mini-Mental State Examination (MMSE) in Spanish. Aging, Neuropsychology, and Cognition,2004: 11(1)1-11.

Figure 2. Mex-Cog Study Content



In total, the cognitive assessment of the study subject is composed of 40 tasks, which are applied in a total (long) or partial (short) version depending on the cognitive performance of the subject. If the study subject obtains a score higher than 10 points in the MMSE, the long evaluation is applied, continuing until the end of the questionnaire. When the study subject obtains a score of 10 points or less in the MMSE, the short evaluation is applied, continuing until task # 31 after which it is interrupted in consideration of the level of difficulty involved in carrying out the subsequent tasks (see Figure 3).

Figure 3. Distribution of tasks applied in the short and long cognitive assessment

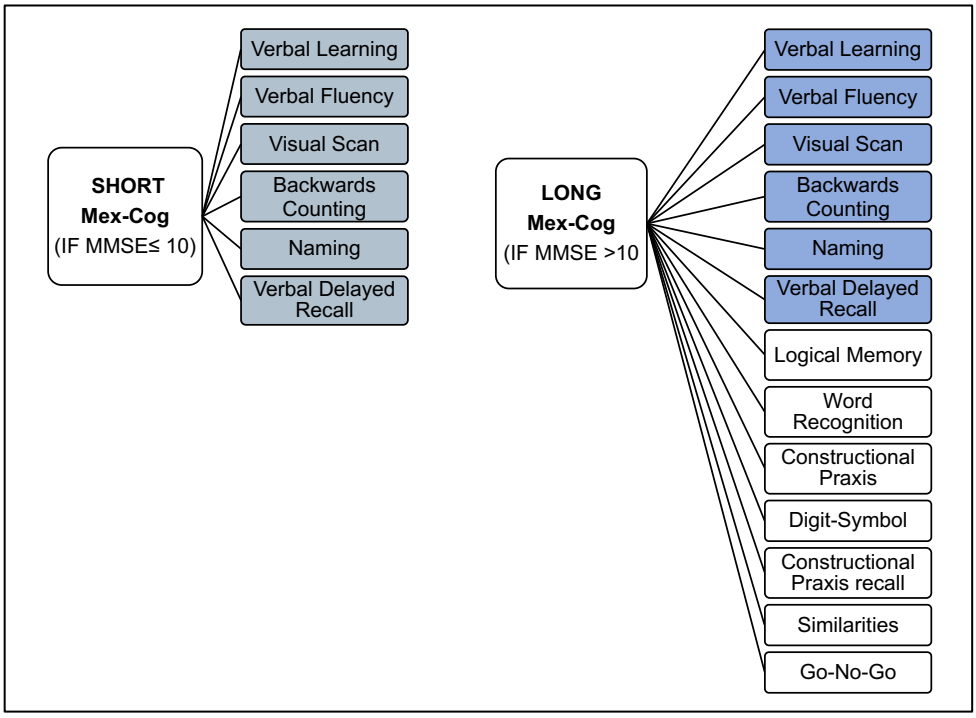
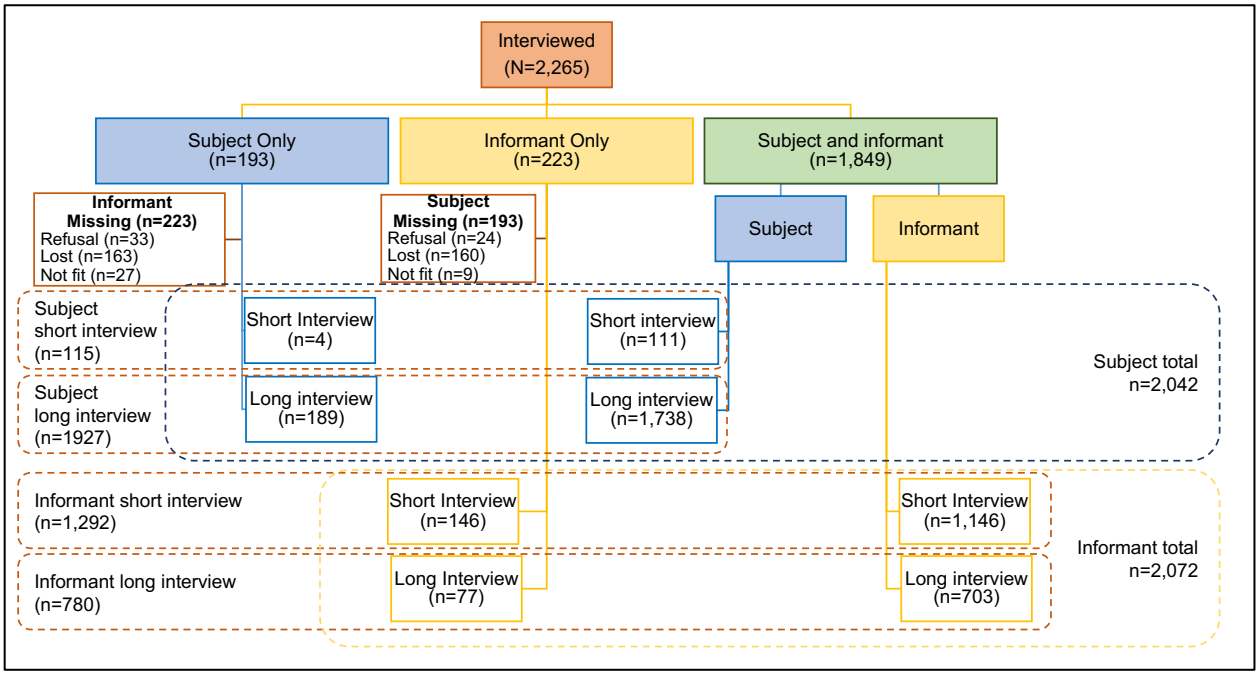


Figure 4 shows the number of casees in which a long and a short versión of the assessment was completed.

Figure 4. Distribution of cases by short and long cognitive assessments



2. Questionnaire for Adequate Informant.

The questionnaire for the adequate informant is also applied in a long or short version. In all cases it starts with the questions of the Community Screening Instrument for Dementia (CSI-D). If the informant answers affirmatively two or more of six questions (questions # 2, 4, 13, 14, 21 and 23), which suggests the presence of a cognitive deterioration process, the long interview is carried out by applying the questions on the origin and history of deterioration (questions # 28 to 41). Otherwise, the short interview is conducted and questions 28 to 41 are not applied; there is a skip to question # 42 to continue with questions about care, attendance at centers, activities at home and activities outside the home.

- *Errata: When defining the filter that determines the performance of the long or short interview, question # 4 (Forget where you put things?) was included by mistake,*

instead of question # 3 being part of the filter (We all have difficulties remembering things as we get older, has this been particularly a problem for him/her?)

3. Anthropometric and Performance Measures.

The following measures were taken, twice each: blood pressure, height, weight and waist circumference, and the balance in both feet was measured (time that can be held standing on each foot); walking speed (time it takes the study subject to walk a distance of four meters), and grip strength in each hand (measured with a dynamometer).

C. Structure of Data Collection

The instruments of the Mex-Cog were applied by interviewers trained in the application of surveys and without experience in the cognitive evaluation, from the National Institute of Public Health. They were trained to apply the questionnaires of the study by professionals from the team of MHAS collaborators, experts in cognitive evaluation, and in taking anthropometric and performance measures. The interviewers applied the cognitive evaluation to the study subject and an interview about the cognitive status of the study subject to an adequate informant. Persons familiar with the behavior and health of the study subject, usually a spouse, child or caregiver, were considered appropriate informants. As in the MHAS protocol, both partners were included in a household if they had been selected for the Mex-Cog. When a selected person had to fulfill both functions (as a study subject and as an adequate informant), the interviewers applied the questionnaire of the informant first and secondly they applied the cognitive evaluation to the study subject. Similar to how it is done in the MHAS surveys, in cases of interviews with couples in a household, and to avoid the learning effect that could occur when listening to the evaluation of the spouse, two different lists of words were applied in the exercises of immediate and delayed memory. The application of the Mex-Cog protocol lasts approximately 60 minutes and the adequate informant interview lasts 20 minutes.

The information was collected in two phases: phase 1 in the spring (March-April) and phase 2 in the fall (October-November) of 2016.

D. Instruments

This section includes specific information about the instruments used in the study.

1. *Cognitive Evaluation*

Table 1 presents the list of tasks grouped according to seven cognitive domains. The text describes in detail each of the tasks included, listed in the order in which they appear on the instrument; The number of points assigned to each task is also indicated.

a) Modified Mini-Mental State Examination (MMSE)

This battery includes:

- Orientation: eight questions about orientation in space and time; one point for each correct answer (max = 8). Note that question number 7 in Orientation is not considered for the Modified MMSE score.
- Immediate Memory - Repeat 3 words: list of three words that the person should repeat after listening to them; one point for each word repeated correctly (max = 3).
- Executive Function - Serial 7: successive subtraction of 7 from 100 for five occasions; one point for each correct successive subtraction considering the previously mentioned number (max = 5).
- Delayed Memory - Delayed recall of 3 words: memory of the list of 3 words previously repeated; one point for each word correctly remembered (max = 3).
- Language:
    - Follow instructions 3 steps: instruction composed of three successive actions that the person must follow after listening to it; one point for each action correctly performed (max = 3).
    - Naming: say the name of two objects presented; one point for each correctly named object (max = 2).

Table 1. Tasks of Cognitive Assessment, Scores, and Missing Values by Cognitive Domain*

Domain	Task	Number of Items	Possible Score	Missing Values**
1. Orientation	1. Day of the month ✓	1	1	.r (23)
	2. Month ✓	1	1	.r (34)
	3. Year ✓	1	1	.r (48)
	4. Day of the week ✓	1	1	.r (36)
	5. What time is it? ✓	1	1	.r (7)
	6. Where are we now? ✓	1	1	.r (10)
	7. How can I get to store to buy a soda?	1	1	.r (13), .i (3)
	8. Country ✓	1	1	.r (7)
	9. State ✓	1	1	.r (11)
	Subtotal	**9**	**9**	
2. Immediate Memory	1. Repeat 3 words ✓	3	3	.r (14), .i (1)
	2.1- 2.3 Repeat 10 words / 3 trials	30	30	.i (3)
	2.4 Total (***)		*30*	
	2.5 Average (***)		*10*	
	3.1 Immediate recall of short story	6	12	.i (3), .c (115)
	3.2 Immediate recall short story – Approx. (***)		*6*	
	3.3 Immediate recall short story – Exact (***)		*6*	
	4.1 Immediate recall of long story	25	50	.i (4), .c (115)
	4.2 Immediate recall of long story – Approx. (***)		*12*	
	4.3 Immediate recall of long story – Exact (***)		*12*	
	Subtotal	**64**	**95**	
3. Delayed Memory	1. Delayed recall of 3 words ✓	3	3	.r (26), .i (1)
	2. Delayed recall of 10 words	10	10	.i (3)
	3.1 Delayed recall of short story	6	12	.i (5), .c (115)
	3.2 Delayed recall short story – Approx. (***)		*6*	
	3.3 Delayed recall of short story – Exact (***)		*6*	
	4.1 Delayed recall of long story	25	50	.i (5), .c (115)
	4.2 Delayed recall of long story – Approx. (***)		*25*	
	4.3 Delayed recall of long story – Exact (***)		*25*	
	5. Recall by recognition of 20 words	20	20	.r (13), .i (5), .c (115)
	6. Delayed recall of 4 figures	4	11	.r (118), .i (5), .l (40), .c (115)
	Subtotal	**68**	**106**	
4. Attention	1. Visual scan	1	60	.r (56), .i (3), .l (88)
	2. Backward counting	1	5	.r (67), .i (3)
	Subtotal	**2**	**65**	
5. Language	1. Following instructions 3 steps ✓	3	3	.r (6), .i (2), .l (36)
	2. Following instructions 2 steps	2	2	.r (19), .i (3)
	3. Naming shoe ✓	1	1	.r (1), .i (2), .l (54)
	4. Naming pencil ✓	1	1	.r (1), .i 2), .l (54)
	5. Naming Elbows	1	1	.r (6), .i (3), .l (53), .m (12)
	6. Define Bridge	1	1	.r (18), .i (3)
	7. Use of Hammer	1	1	.r (10), .i (3)
	8. Use of Scissors	1	1	.r (8), .i (3)
	9. Repetition ✓	1	1	.r (27), .i (2)
	10. Reading ✓	1	1	.r (2), .i(2), .l (54), .s (273)
	11. Writing ✓	1	1	.r(26), .i (3), .l (83), .s (340)
	Subtotal	**14**	**14**	
6. Constructional Praxis	1. Copy one figure ✓	1	1	.r (4), .i (3), .l (76)
	2. Copy 4 figures	4	11	.r (14), .i (5), .l (45), .c (115)
	Subtotal	**5**	**12**	
7. Executive Function	1. Serial 3	5	5	.r (284), .i (1)
	2. Serial 7 ✓	5	5	.r (218), .i (1)
	3. Verbal Fluency	1	4	.r (9), .i (3)
	4. Symbols and Digits	1	56	.r(69), .i (5), .l (41), .c (113)
	5. Similarities	3	3	.r(3), .i (5), .c (115)
	6. Go no Go	10	10	.r (21), .i (5), .l (18), .c (115)
	Subtotal	**25**	**83**	
TOTAL		**187**	**384**	

(*) The grouping of tasks by domain is suggested by the Mex-Cog project. Users can group tasks differently.
(**) r. = does not respond; .i = incomplete; .l = physical or visual limitation; .c = short interview; .s = jump; .m = no response Frequencies out of n = 2,042.
(***) Variables also available in the database, but not considered in the calculation of Total Score.
✓ These ítems are considered for Modified MMSE (28 points)

- Repetition: short phrase that the person must repeat; one point for having said the whole phrase (max = 1).
- Reading: written instruction that the person should read and carry out; one point for reading and following the instruction (max = 1).
- Writing: the person must write a sentence that transmits a message, spelling errors are ignored; one point for the correctly written sentence (max = 1).

- Constructional Praxis - Copy one figure: copy of two overlapping pentagons, see scoring instructions in Table 3 (max = 1).

b) The total score of the modified MMSE is 28 points.Verbal Learning

This task consists of reading the study subject a list of 10 words during three occasions. The subject must repeat the words s/he remembers after each presentation. The score corresponds to the number of words repeated correctly in each presentation (max = 10). In the database, the total score is also recorded in the three opportunities (max = 30) and the average score of the three opportunities (max = 10).

c) Verbal Fluency

The study subject must name all the animals that come to his/her mind for a minute. The interviewer writes down all the names including those repeated. The number of animals mentioned including the repeated ones, and the number of repetitions are scored. The maximum score depends on the performance of each study subject. However, the total score of correct animals is recoded according to the following scale (0-8 = 1, 9-18 = 2, 19-24 = 3, 25-36 = 4). This recoded score (1-4) is used for the sum of all tasks within the executive function domain.

d) Visual Scan

In this task the study subject is presented with a sheet of paper with 369 different figures and a stimulus card with the drawing of one of the figures. The study subject must mark with a pencil all the figures that are equal to the one in the stimulus card as fast as possible within a time limit of one minute. The number of correct figures is scored (max = 60). In the database the number of incorrect figures is also included, that is, marked figures that do not correspond to the one presented in the stimulus card (max = 309).

e) Backwards Counting

The study subject is asked to count backwards from 20 to 0. The time it takes to count from 20 to 11 or from 19 to 10 is recorded. If the study subject makes an error, he is offered a second chance to complete the task. In case of taking a second chance, these results are considered for the score. It is counted as correct when the study subject does not make any error (max = 1). A variable is also included in the database with the time it takes to perform the countdown (measured in seconds). A recoded time score is obtained according to the following scale (3-10 seconds = 4, 11-20 = 3, 21-30 = 2, 31-59 = 1), which is used for the sum of the attention domain. Finally, a score that combines both indicators (correct / incorrect and time) coded as follows is also considered: 0 = incorrect; 1 = correct and out of time; 2 = 31-60 seconds; 3 = 21-30 seconds; 4 = 11-20 seconds; 5 = 3-10 seconds).

f) Language

- Name Elbows: What is this called? (elbows)
- Define Bridge: What is a bridge?
- Use of the Hammer: What is done with a hammer?
- Use of Scissors: What is used to cut paper?
- Give directions: Could you tell me how to get to a store to buy a soft drink
- Following instuctions 2 steps: point with your finger, first to the sky and then to the ground.

These 6 tasks are scored as correct or incorrect following the criteria included in each question within the questionnaire (max = 1 each). Taken together, these questions were adapted from the evaluation carried out by the 10/66 Dementia Study and included in the short version of the Community Screening Instrument for Dementia (CSI'D) (Stewart, Maelenn & Prince, 2016[3]).

[3] Stewart R, Guerchet M, Prince M. Development of a brief assessment and algorithm for ascertaining dementia in low-income and middle-income countries: the 10/66 short dementia diagnostic schedule. BMJ Open. 2016 May 25;6(5):e010712. doi: 10.1136/bmjopen-2015-010712.

g) Delayed Recall of 10 Words

In this task the study subject must say all the words that he/she remembers from the list of 10 words that were read in the verbal learning task (max = 10).

h) Delayed Recall of Short Story

The interviewer reads a story composed of 6 basic ideas about a fire. After having listened to it, the study subject must repeat it as completely as possible. It is rated based on the list of the 6 ideas: a total score from the exact (2 points) or approximate (1 point) presence of each idea is rated in the subject's account of the story (max = 12). The database also includes an exact score where one point is assigned to each idea if it was mentioned exactly (max = 6) only, and another score where a point is assigned to each idea remembered exactly or approximate (max = 6).

i) Delayed Recall of Long Story

The interviewer reads a story composed of 25 basic ideas about a fire. After having listened to it, the study subject must repeat it as completely as possible. It is rated based on the list of the 25 ideas: a total score where the exact (2 points) or approximate (1 point) mention of each idea is rated in the subject's account (max = 50). The database also includes an exact score where a point is assigned to each idea if it was mentioned exactly only (max = 25), and another score where a point is assigned to each idea mentioned exactly or approximate (max = 25).

j) Recall by Recognition of 10 Words

In this task the interviewer reads a list of 20 words that includes the 10 words from the verbal learning list and another 10 different words. The study subject must identify if each of the words read is part of the original list, or not. The correct answers are scored (max = 20).

k) Copy 4 Figures

Figures are presented to the study subject one by one, in separate sheets, each with the drawing of a geometric figure (circle, diamond, rectangle and cube). The study subject must copy each figure below the sample. The figures are graded depending on the

assigned criteria (see Table 3). The sum of the individual grades is considered to calculate the domain score of constructional praxis (max = 11).

l) Symbols and Digits

In this task, the subject is presented with a sheet with four rows of digits (1 to 9) separated by lines, below which are nine blank boxes. The study subject must fill (in 90 seconds) the maximum number of blank boxes with the symbol (figure) that corresponds to the each digit following a printed sample box. The total number of boxes filled correctly is scored (max = 56).

m) Delayed Recall of 4 Figures

The study subject is asked to draw from memory the geometric figures that s/he previously copied in the task of constructional praxis. They are scored according to the same criteria (see Table 2, max = 11).

n) Delayed Recall of Short Story

The study subject is asked to remember again the story that was read to her/him previously and that he/she repeated making reference to the story of the fire. It is scored in the same way as the immediate recall of the short story.

o) Delayed Recall of Long Story

The study subject is asked to remember again the story that was read to her/him previously and that he/she repeated making reference to the story of the robbery. It is scored in the same way as the immediate memory of the long story.

p) Similarities

The study subject is told three pairs of words (banana-orange, table-chair and rose-daisy) and asked how they are similar. Each response is scored as correct if it meets the expected response (i.e. fruits, furniture, flowers) (max = 1). The sum of the three individual scores is considered for the total score of all tasks within the executive function domain (max = 3).

q) Go-No-Go

The subject must follow the instructions to applaud once when the interviewer applauds once and not-applaud when the interviewer applauds twice. There are 10 exercises of one or two applauses so that the study subject follows the instructions. The hits (max = 10) and the misses (max = 10) are scored.

After completing the application of the cognitive exercises, a series of questions follow that the study subject must answer by self-report.

- Self-reported Memory: Current state of the ability to remember (1 = excellent and 5 = bad) and compares current recall ability with the ability two years ago (1 = best and 3 = worst).
- Depressive Symptoms: 9 questions about the current presence (yes-no) of depressive symptoms (max = 9).
- Lead Exposure: Ever eaten food in glazed pottery (picture of the crockery is shown). In case of an affirmative answer, he/she is asked about the elapsed time since the last time. If the answer was less than a year ago, then s/he is asked about the frequency with which they use this type of crockery.
- Skull Trauma: Presence of a blow to the head during his/her life. If it is affirmative, they are asked if they lost consciousness.

2. *Questionnaire for Adequate Informant*

The questionnaire for the informant is composed of three parts (see Table 2):

a) The first part consists of 28 questions about the cognitive state (19) and the functional performance (9) of the study subject adapated from the Community screening interview for dementia (CSI-D) of Hall et al. (1993[4]). The response options are of two types. For some questions the informant answers yes or no, depending on whether the subject of the study presents or not the aforementioned behavior. For other questions, the response depends on the frequency with which the behavior is presented on a scale of 0 to 2.

[4] Hall K, Hendrie H, Brittain H, Norton JA. The development of a dementia screening interview in two distinct languages. Int. J. Methods Psychiatr. Res. 1993;3:1–28.

Table 2. Informant Interview Items, Scores, and Missing Values by Domain

		Possible Items or Points	Missing values*
1. Cognitive Decline	1. Change in daily activities	3	.d (4)
	2. Change in mental functioning.	1	-
	3. Serious problems remembering.	1	.d(10), .r(1)
	4. Forgets where she/he put things.	2	.d(8)
	5. Forgets where things are usually kept	2	.d(16), .i(1)
	6. Forgets friend's names	2	.d(16), .i(3) .r(1)
	7. Forgets names of family members	2	.d(7), .i(3)
	8. Forgets what to say in the middle of conversation	2	d(8), .i(3)
	9. Forgets words when speaking	2	.d(4), .i(3), .r(3)
	10. Uses wrong words	2	.d(8), .i(3), .r(1)
	11. Talks more about the past	2	.d(5), .i(3), .r(1)
	12. Forgets when she saw you last time	2	.d(12), .i(3), .r(2)
	13. Forgets what happened day before	2	.d(22), .i(3), .r(1)
	14. Forgets where he/she is	2	.d(1), .i(3), .r(1)
	15. Gets lost in the neighborhood	2	.i(3), r(1)
	16. Gets lost at home	2	.d(4), .i(3), .r(1)
	17. Difficulty adjusting to changes in daily routine.	2	.i(3), .r(19)
	18. Changes in the ability to think or reason.	1	.i(3), .r(12)
	19. Mistaken a family member or friend for another person	1	.d(3), .i(3), .r(1)
	20. Difficulty making decisions about daily life.	1	.d(18), .i(3), .r(1)
	21. Thought process is confusing or illogic	1	.d(7), .i(3), .r(2)
	Subtotal	**37**	
2.Functional Decline	1. Difficulty with usual household chores	2	.d(6), .i(3), .r(1)
	2. Stopped doing usual activities or hobbies	1	.d(13), .i(3), .r(1)
	3. Difficulty managing money	2	.i(3), .r(14)
	4. How is the ability to eat	3	.i(3), .r(11)
	5. How is the ability to get dressed	3	.i(3), .r(4)
	6. Difficulty controlling urine	2	.i(3), .r(93)
	7. Difficulty controlling bowel movement	2	.i(3), .r(94)
	Subtotal	**15**	
	Total	**52**	

*.d = does not know; r. = does not respond; .i = incomplete

b) The second part consists of 11 questions about the history and the etiology of cognitive impairment adapted from the HAS scale of Dewey and Copeland (2001[5]). This section does not have a quantitative score because it is aimed at characterizing the way in which the cognitive deterioration of the study subject has evolved (for example, time of onset of symptoms, form of onset, type of evolution of symptoms).

c) The third part consists of 17 questions about care needs (3), attendance at centers (2), activities within the home (5) and activities outside the home (7). The response options are of two types. For some questions the informant answers yes or no depending on whether the study subject presents the characteristic or performs the activity; for other questions the response depends on the frequency with which the study subject performs the activity or the time that he dedicates to it using a scale from 1 to 5.

3. *Anthropometric and Performance Measures*

The instrument of anthropometric measurements and performance has three parts:

a) The first includes taking blood pressure at the beginning of the protocol. Three measurements are recorded: systolic pressure, diastolic pressure and pulse, in addition to the time at which the measurement was carried out. If it was not possible to take the measures, the possible reasons for this situation are recorded. After the first blood pressure measurement, we proceed to determine if the person can stand without support, a necessary condition to take the anthropometric and performance measurements. In case they are unable to stand without support, we proceed to the second blood pressure reading where the same information is recorded and the protocol stops. If the study subject is able to stand without support, a second blood pressure measurement is made after the anthropometric measurements.

b) Antropometric Measures:

1) Height: For the measurement of height it is necessary that the study subject does not have a visible curvature of the spine. If there is curvature, it is not possible to take the height and we proceed to the measurement of weight. In case of not having the curvature, the ability to achieve a straight posture is recorded and the

[5] Dewey ME, Copeland JR. Diagnosis of dementia from the history and aetiology schedule. Int J Geriatr Psychiatry. 2001 Sep;16(9):912-7.

height is taken twice (measured in centimeters and millimeters). The reasons that prevented the measurement of height are also recorded if this happens on both occasions.

2) Weight: The study subject must stand on the scale on two different occasions for weight measurement. Weight is recorded (measured in kilos and grams) and the reasons that prevented the weight measurement if this happens.

c) Performance Measures

1) Balance: For each foot, the study subject is asked to try to stand without support, first on the right foot. The time in seconds that he/she can do it is recorded, considering a maximum time of 10 seconds. The same is repeated with the left foot. If the exercise cannot be done, the reason is recorded.
2) Walking Speed: The study subject must walk in a straight line a distance of four meters. The time the study subject uses to travel this distance (measured in minutes and seconds) and the required aids (cane or others) is recorded. If the study subject does not perform the exercise, the reasons that prevented it are recorded and there is a skip to the measurement of grip strength. If it has been achieved, the walking speed is measured again, the required aids and the reasons that prevented it from doing it again are recorded if this happens.
3) Grip Strength: Gripping or grasping strength is defined as the quantifiable ability to exert pressure with the hand and fingers. The study subject must squeeze the handle of a dynamometer with the maximum possible force for two seconds, first with the dominant hand and then with the other, standing and forming with the arm an angle of 90 degrees (measured in kilograms). Two measurements are made with each hand and the reasons why the test was not performed are recorded if this happens.

III. Processing of Information

A. Data collection

Most of the data collection by the interviewers was carried out by means of a laptop directly in the field following the filters, jumps and qualifications specified in the questionnaire. Some of the cognitive tasks were collected using paper and pencil as required, such as tasks that involved drawing, writing, or working on paper. These tasks were later scored by two trained people who digitized the results which were later added to the final database. Table 3 shows the scoring criteria for these tasks.

B. Databases

The databases contain the names of the variables that correspond to the questions of each questionnaire, as well as the labels of the answers. The special non-response values have also been identified, which correspond to skips within the questionnaire or faults in the survey equipment or in some cases by an incomplete questionnaire.

There are four databases:

1) Cognitive evaluation of the study subject
2) Interview of adequate informant
3) Anthropometric and performance measures
4) Master Follow-up file

The Mex-Cog Master Follow-up File was designed to provide information at the individual level from the individuals selected for the survey (n = 3,250). Therefore, the file includes a record even for selected individuals who were not interviewed (See Figure 1). The file contains all the identifiers used in the MHAS 2015, the general result of the Mex-Cog interview, as well as the result of each of the elements of the study (cognitive evaluation, interview with the adequate informant, and anthropometric and performance measures).

Table 3. Scoring criteria for tasks performed on paper and pencil

Exercise	Evaluation Critieria	Values
Writing	Complete idea (sentence) that conveys a message (spelling errors are not considerered).	(0-1)
Praxias 	It is qualified as correct (1) if it meets the following conditions: 1. Two figures with fives sides 2. Figure of four sides when superimposing the two figures	(0-1)
Animals	Total words registered	(0-36)
	Correct answers (repeated animals are counted once)	(0-36)
	Total repeated animals	(0-36)
Visual scanning 	Total of correct figures marked	(0-60)
	Total incorrect figures marked	(0-60)
Constructional praxis	**Circle** (each condition is worth a point):  1. Circular form 2. Closed figure (3mm)	(0-2)
	Diamond (each condition is worth a point):  Four-sided figure 1. Four closed angles (3mm) 2. Four sides approximately the same size	(0-3)
	Rectangles (each condition is worth a point):  1. Two rectangles present 2. The superposition of the rectangles is equal to the model	(0-2)
	Cube (each condition is worth a point):  1. A three-dimensional figure is observed 2. The front face is directed to the left or right 3. Right inner lines 4. Parallel opposite sides	(0-4)
Symbols and digits	Total attempts (counting boxes left blank)	(0-56)
	Total correct answers	(0-56)
Constructional praxis recall	**Circle** (each condition is worth a point):  1. Circular form 2. Closed figure (3mm)	(0-2)
	Diamond (each condition is worth a point):  1. Four-sided figure 2. Four closed angles (3mm) 3. Four sides approximately the same size	(0-3)
	Rectangles (each condition is worth a point):  1. Two rectangles present 2. The superposition of the rectangles is equal to the model	(0-2)
	Cube (each condition is worth a point):  1. A three-dimensional figure is observed 2. The front face is directed to the left or right 3. Right inner lines 4. Parallel opposite sides	(0-4)

The variables included in the file are briefly described below:

- *Identifiers*: the same identifiers used in MHAS 2015 are included to identify the household and the individual. That is, the unique CUNICAH household, the sub-household (SUBHOG_15) and the unique identifier of the subject (NP).[6] By using the CUNICAH and NP identifiers, together, one can merge the Mex-Cog files with the MHAS 2015 files.[7]
- *Interview Result Indicators*: a series of variables were constructed to indicate the result of each of the components of the Mex-Cog.
    - *RES*_MXCOG_COMP_16: a variable of 4 characters (or string) that indicates the result of the cognitive evaluation to the subject, the interview to the adequate informant, and the anthropometric and performance measures, in that order.
    - *RES_MXCOG_16*: a categorical variable that indicates the general result of the study in the following way; (1) a complete interview (that is, the three components of the study were completed); (2) an incomplete interview, that is, at least one of the components was not completed; (3) indicates that the subject refused to participate; (4) the subject could not be contacted; (5) the subject had died; and (6) the subject was not in a position to complete the study and did not have an adequate informant.
    - *RES*_COGNITIVO_16, RES_INFORMANTE_16, y RES_ANTRO_16: dichotomous variables that indicate whether the respective component was completed or not.
    - *PHASE_MXCOG_16:* study phase (1 or 2) when the interview was applied.
    - *MONTH_MXCOG_16 y DATE_MXCOG_16:* month in which the interview was completed. The second variable is encoded in STATA format.

[6]For more information about the identifiers used in the MHAS see “Source: MHAS (2013), The Mexican Health and Aging Study: “MHAS 2012 Data Files Description, Version1, September 2013.” Retrieved from www.MHASweb.org on (February 2015).
[7]For more information on how to paste the MHAS databases, see: "MHAS 2001, 2003, 2012 & 2015 - Merging Files Across Waves", a tutorial for new MHAS users, available in the study forum or here.

C. Codebooks

Each codebook reflects a corresponding data file.

1. *Cognitive Evaluation*

The codebook contains all the variables of the database referring to the performance of the study subject in the mentioned tasks. In addition, other constructed variables are included:

- Possible maximum points by cognitive domain. The points are provided for each domain. The grouping suggested in this version is:
  - Orientation (Domain 1),
  - Immediate memory (Domain 2),
  - Deferred memory (Domain 3),
  - Attention (Domain 4),
  - Language (Domain 5),
  - Constructional Praxis (Domain 6), and
  - Executive function (Domain 7).
- Number of correct points for each task within the domain.
- Number of correct points per domain.
- Number of máximum points corresponding to the tasks that were attempted per domain. This variable is useful in cases in which the study subject refused or did not attempted to perform all the tasks of a domain, for example due to sensory problems.

The names of the variables were designated as follows: for example, D1_t1 refers to the correct points of task 1 within domain 1.

Appendix A includes a series of flowcharts that indicate how to assign points for each task; and by cognitive domain, how to assign points for each domain.

2. *Adequate Informant Questionnaire*

The codebook contains all the variables that make up the informant's questionnaire. Additional constructed variables were also included. For each type of impairment (cognitive and functional):

- The score of each item by type of impairment.
- The total score by type of impairment (Max=37 for cognitive and Max=15 for functional).
- The total number of items completed by type of impairment.
- Total score for CSI-D (Max=52).
- Attempted points for CSI-D.
- FILTER1: Variable that indicates whether the study subject did a short interview or a long interview according to the original filter.
- FILTER2: Variable that indicates whether the adequate informant did a short interview or a long interview according to the corrected filter (see errata, Conceptual Design and Study Content Section).
- MI_TIPENT_INFORMANT_16: Variable that indicates whether the Informant interview was short, long, or incomplete. This variable replaces FILTER1 and FILTER2 in version 3 of the data file (March, 2020)

3. *Anthropometric and Performance Measures*

All the variables corresponding to the anthropometric and performance measurements indicated in the questionnaire are included.

Appendix A.

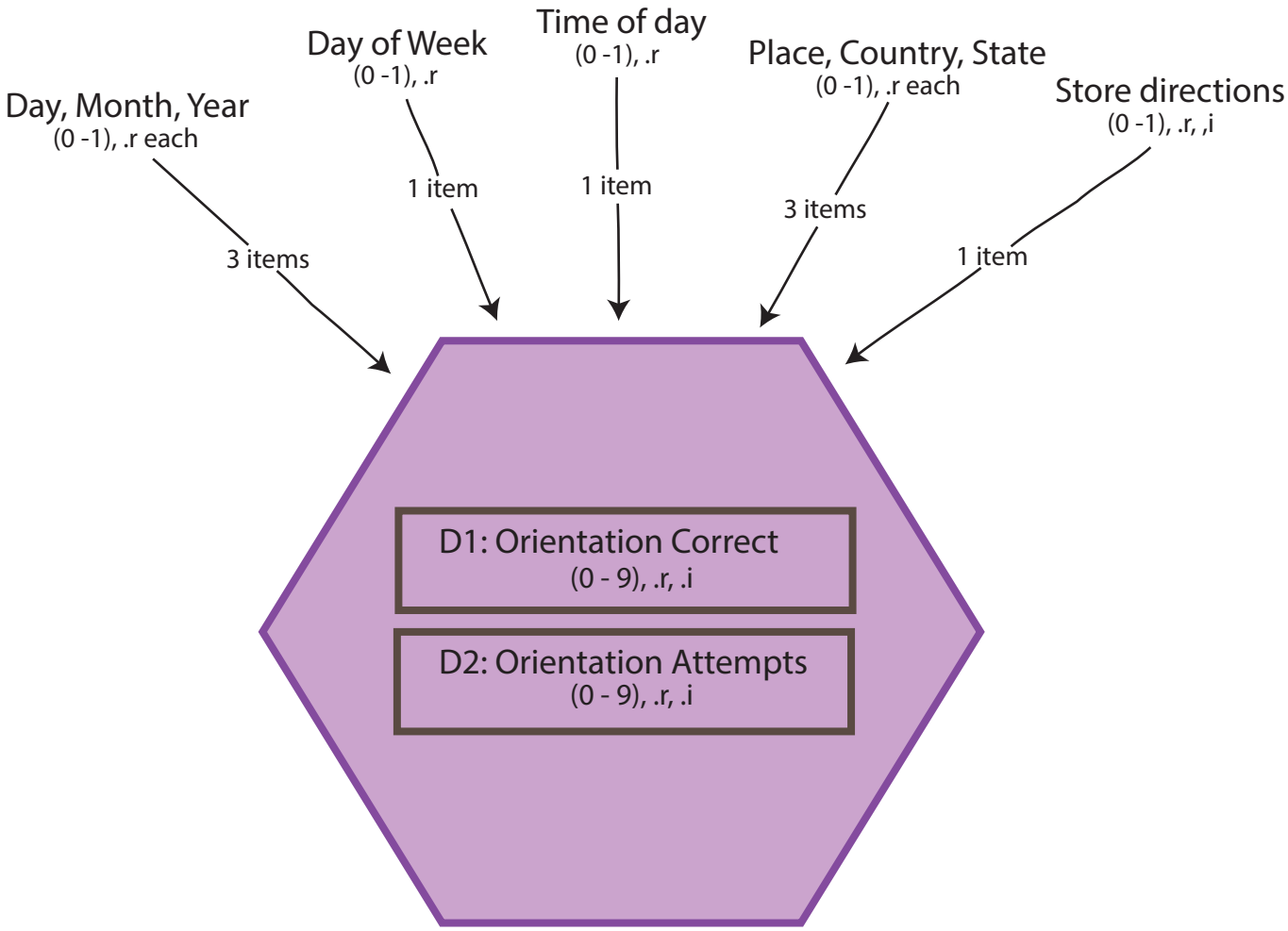
Mex-Cog 2016 Flowcharts for Scoring and Constructed Variables by Domain

Version 2

Last updated January 2020

1. ORIENTATION

n = 2,042

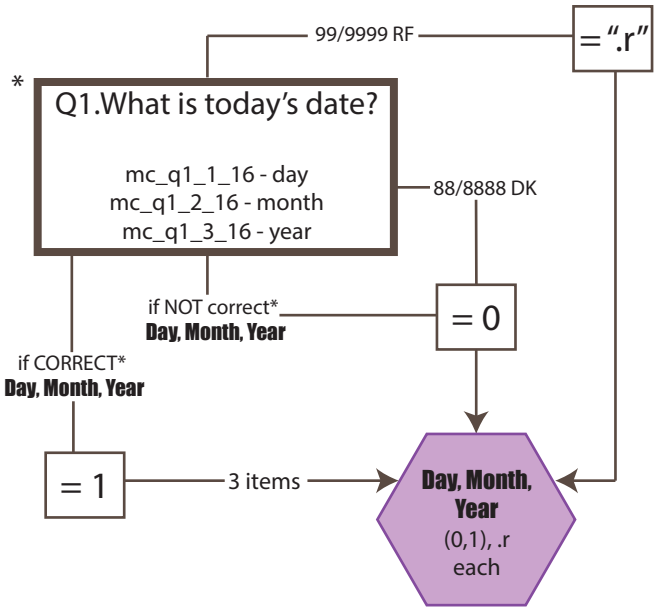


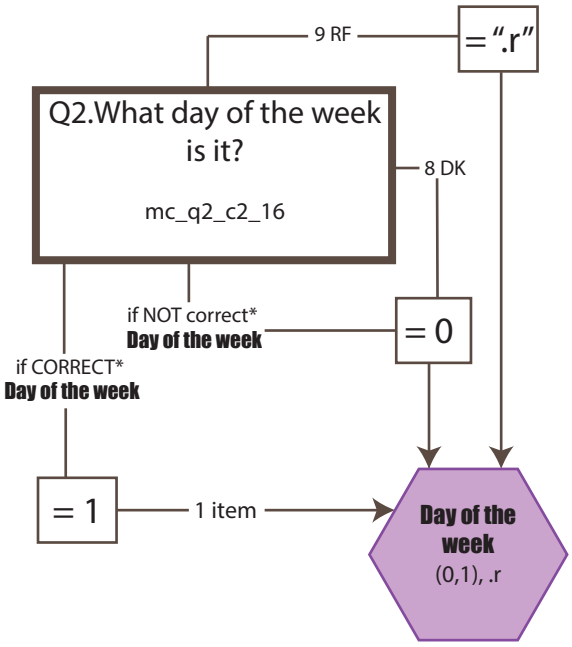
Correct = { Sum (correct out of 9 points if ≠ .r, .i)
.r if all items are .r
.i if all items are .i

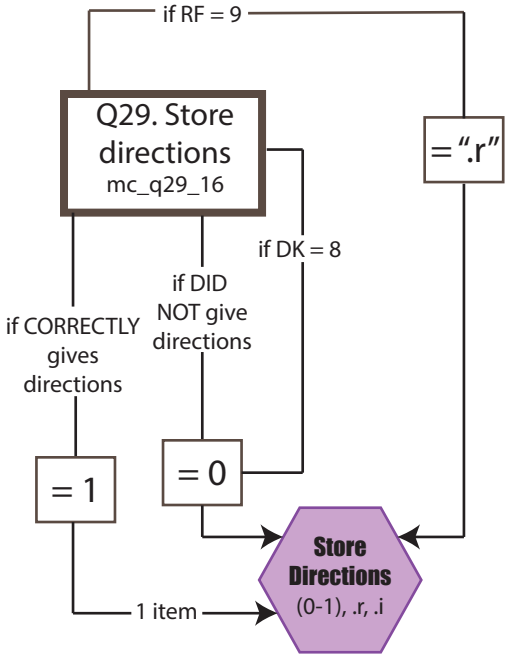
Attempts = { Sum (maximum out of 9 points if ≠ .r, .i)
.r if all items are .r
.i if all items are .i

D1. ORIENTATION SCORE FLOW CHART

n = 2,042

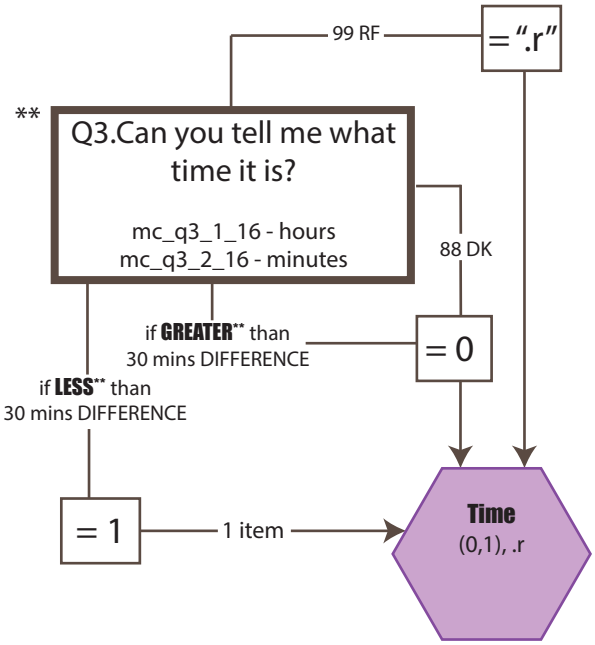


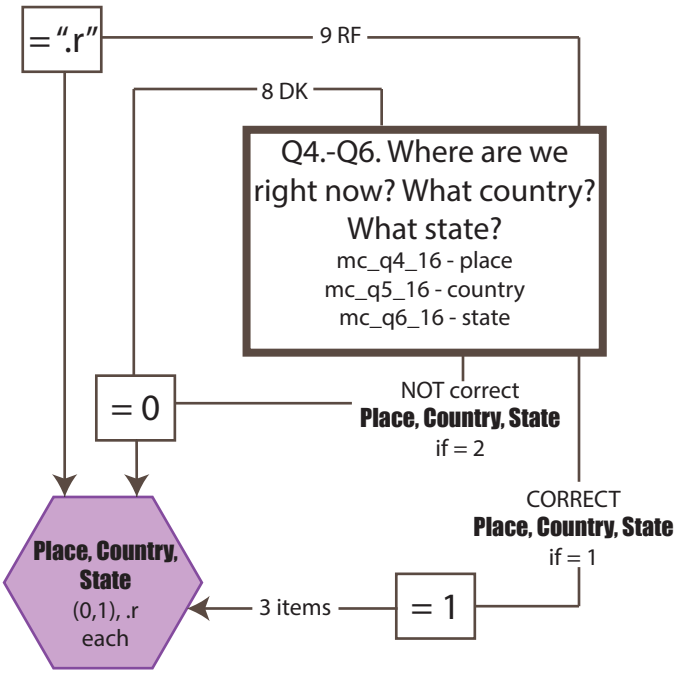




* **CORRECT** is determined by comparing the Respondent's answer with the correct data (day, month, year) provided by the system.

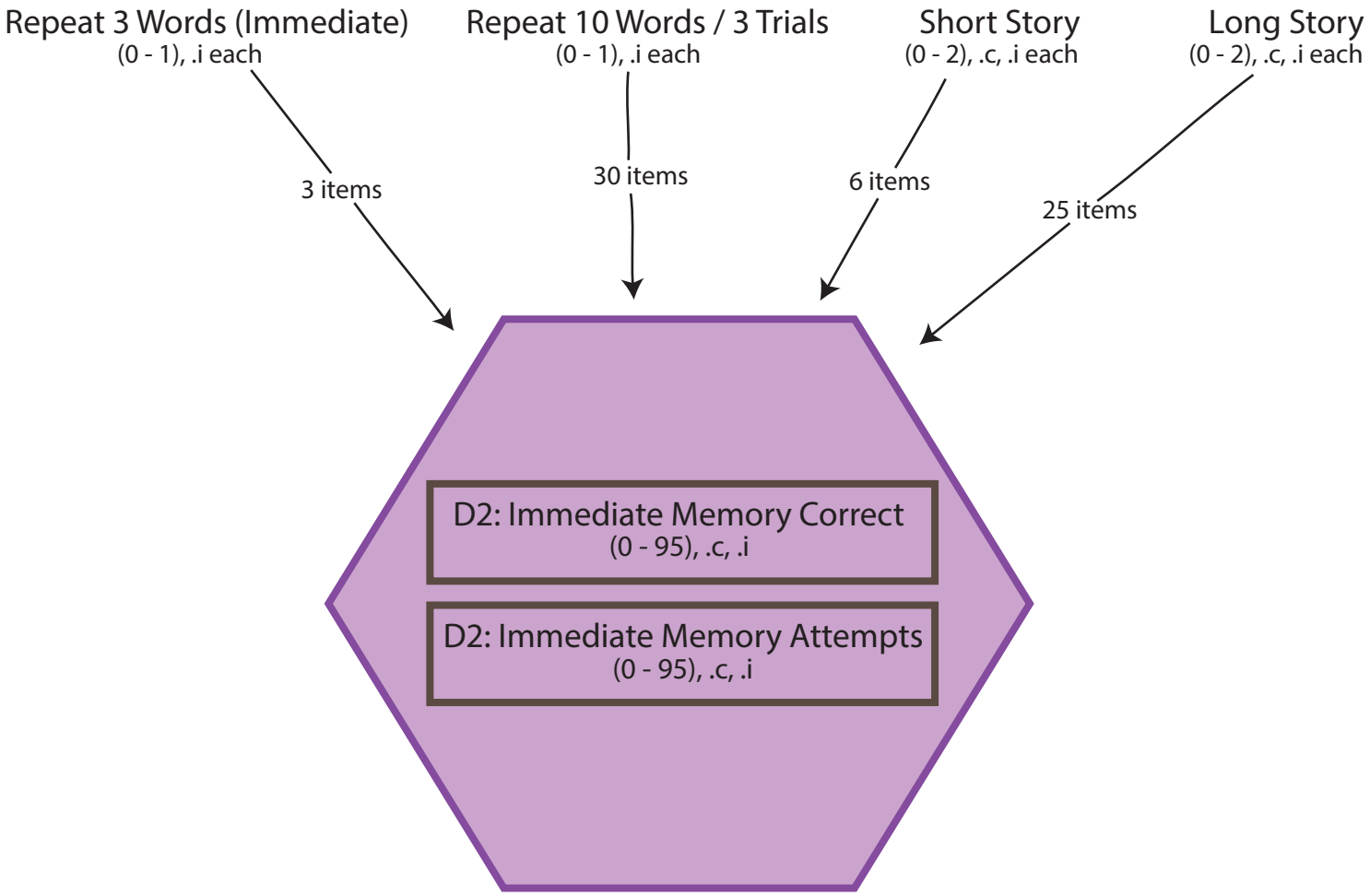
** **DETERMINED** by comparing Interviewer's recorded time versus the Respondent's recorded time.





2. IMMEDIATE MEMORY

n = 2,042

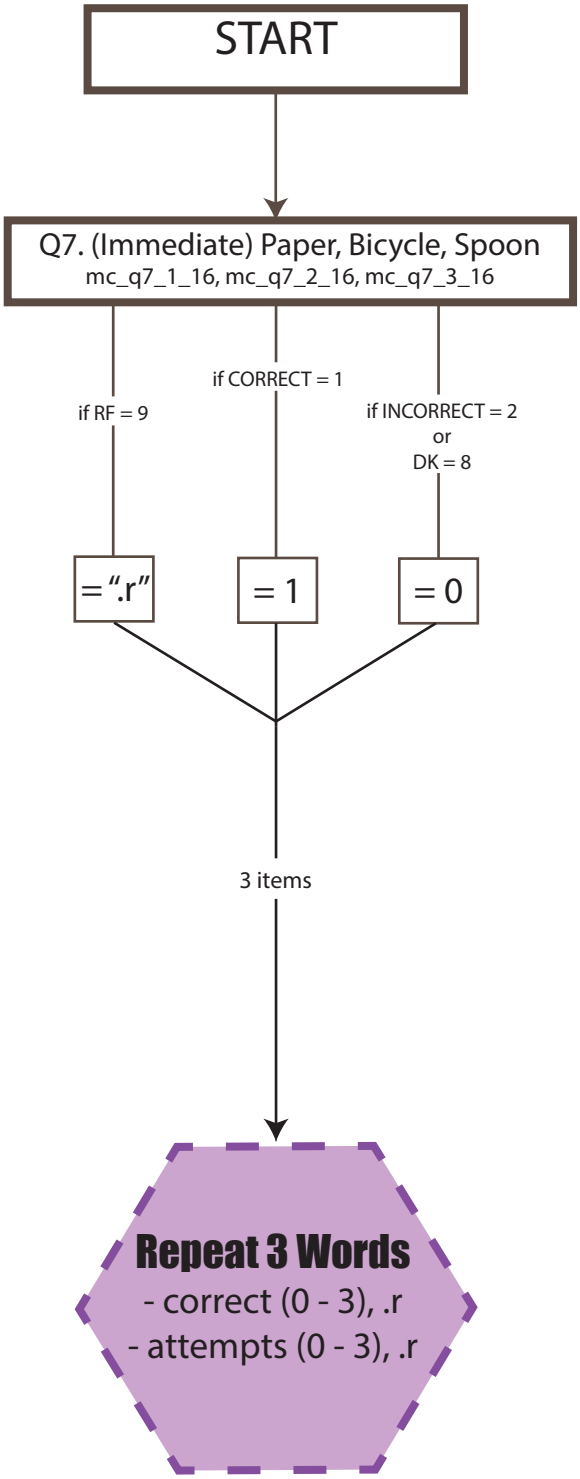


Correct = { Sum (correct out of 95 points if ≠ .c, .i)
.c if all items are .c
.i if all items are .i

Attempts = { Sum (maximum out of 95 points if ≠ .c, .i)
.c if all items are .c
.i if all items are .i

D2.1 REPEAT 3 WORDS SCORE FLOW CHART

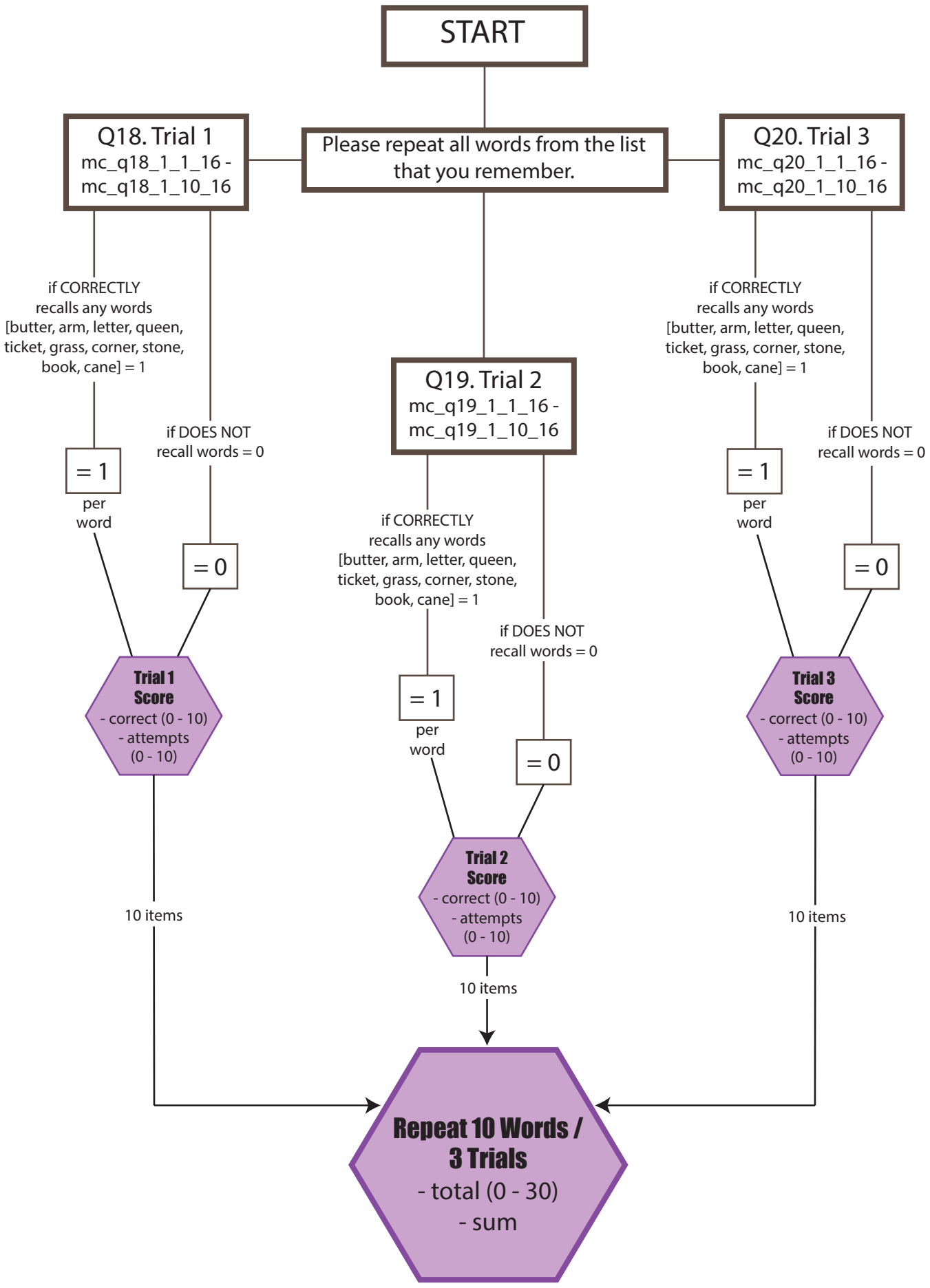
n = 2,042



NOTE: Dashed border means sentence / words are different from H_CAP

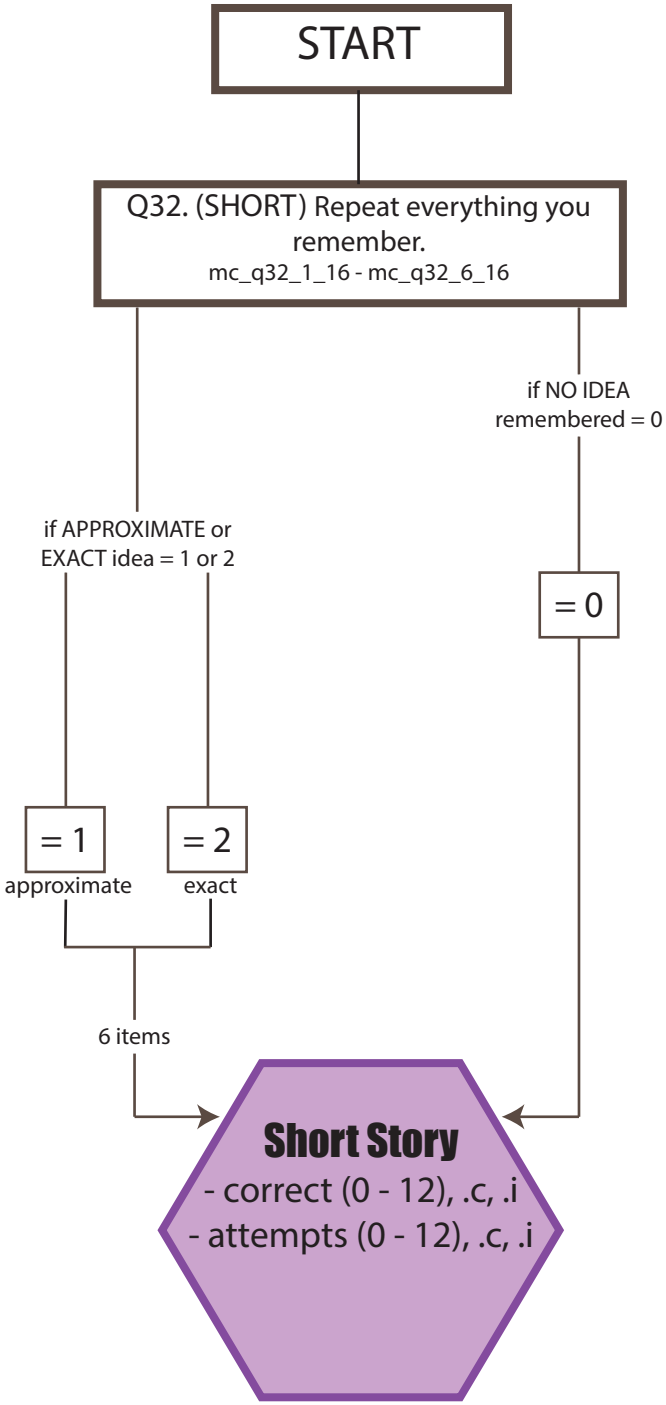
D2.2 REPEAT 10 WORDS / 3 TRIALS SCORE FLOW CHART

n = 2,039



D2.3 IMMEDIATE RECALL OF SHORT STORY SCORE FLOW CHART

n = 1,923



NOTE:

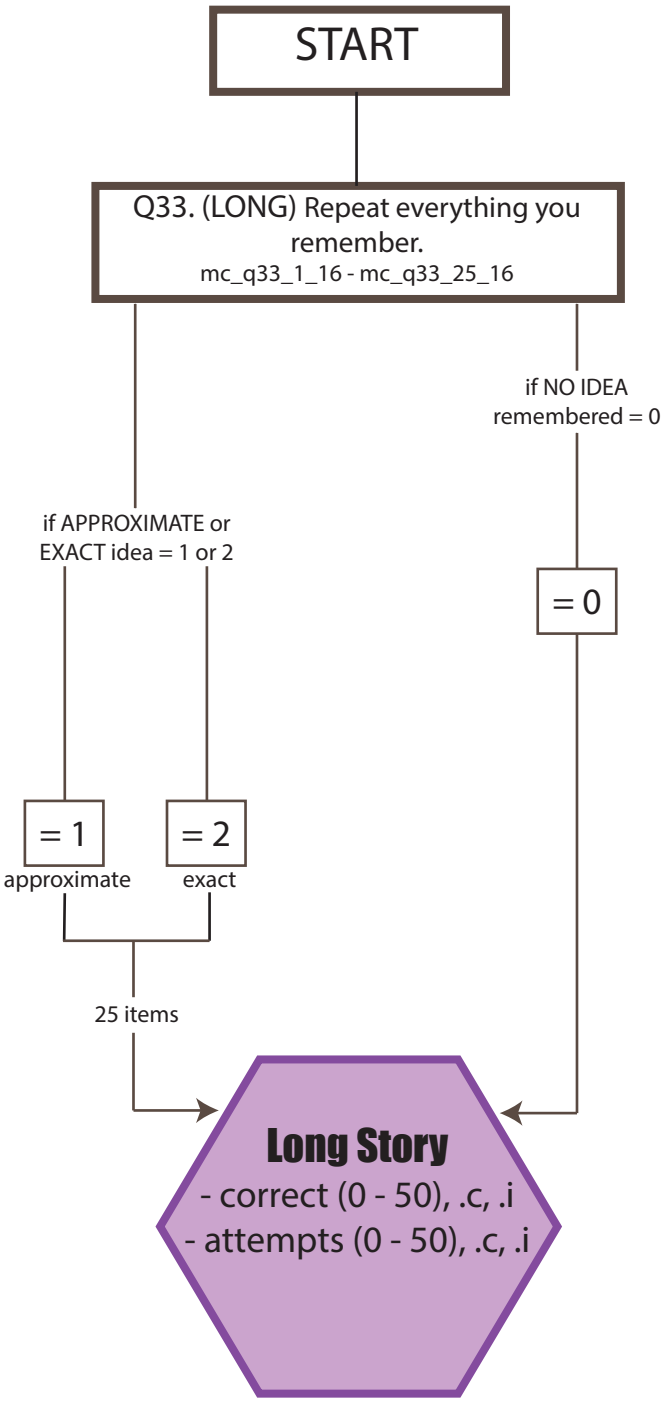
Two other variables were created to reflect scores as follows:

D2_t3_2 → 1 if exact or approximate, 0 if NO IDEA remembered

D2_t3_3 → 1 if exact, 0 if approximate or NO IDEA remembered

D2.4 IMMEDIATE RECALL OF LONG STORY SCORE FLOW CHART

n = 1,923



NOTE:

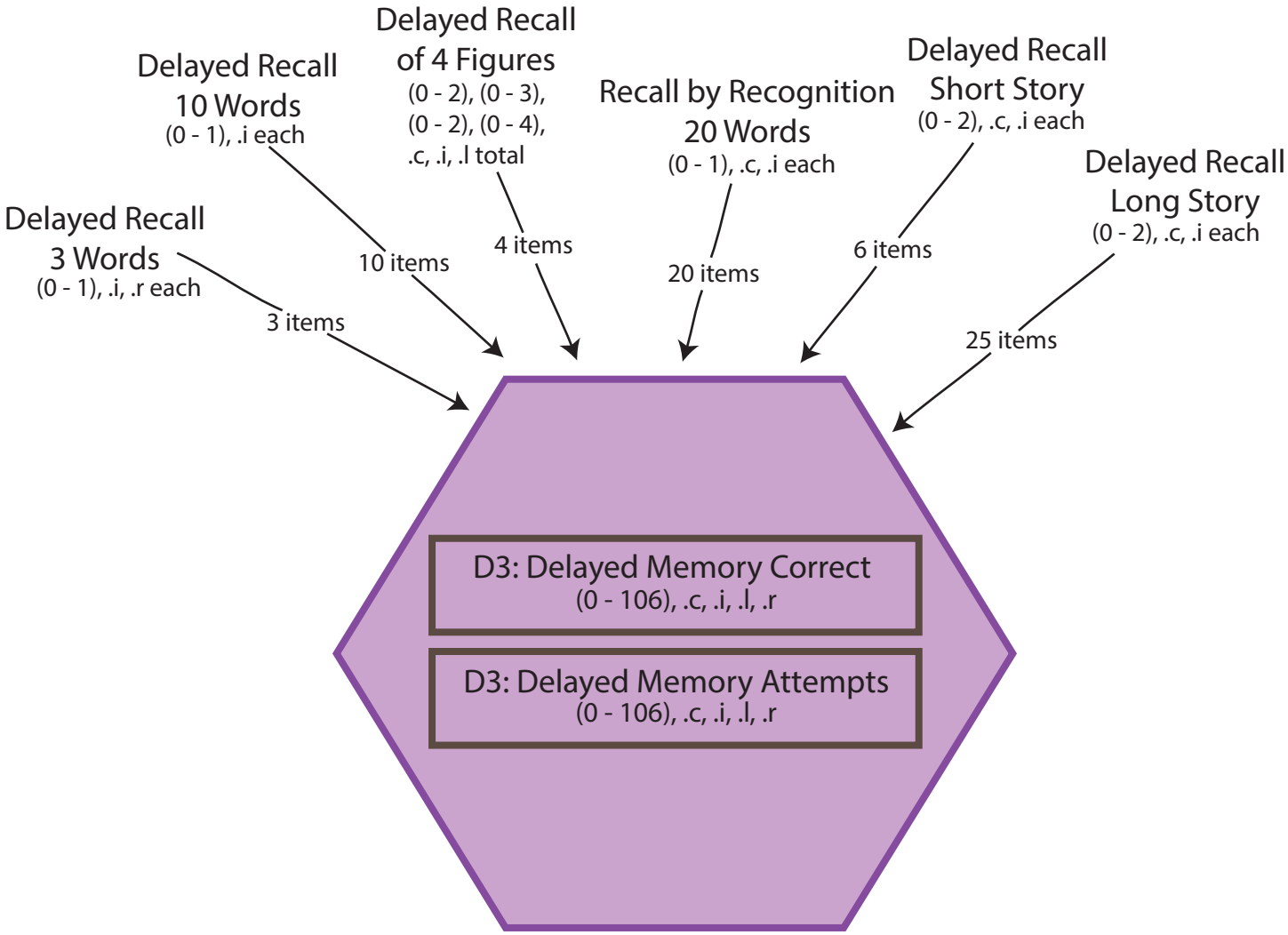
Two other variables were created to reflect scores as follows:

D2_t4_2 → 1 if exact or approximate, 0 if NO IDEA remembered

D2_t4_3 → 1 if exact, 0 if approximate or NO IDEA remembered

3. DELAYED MEMORY

n = 2,042

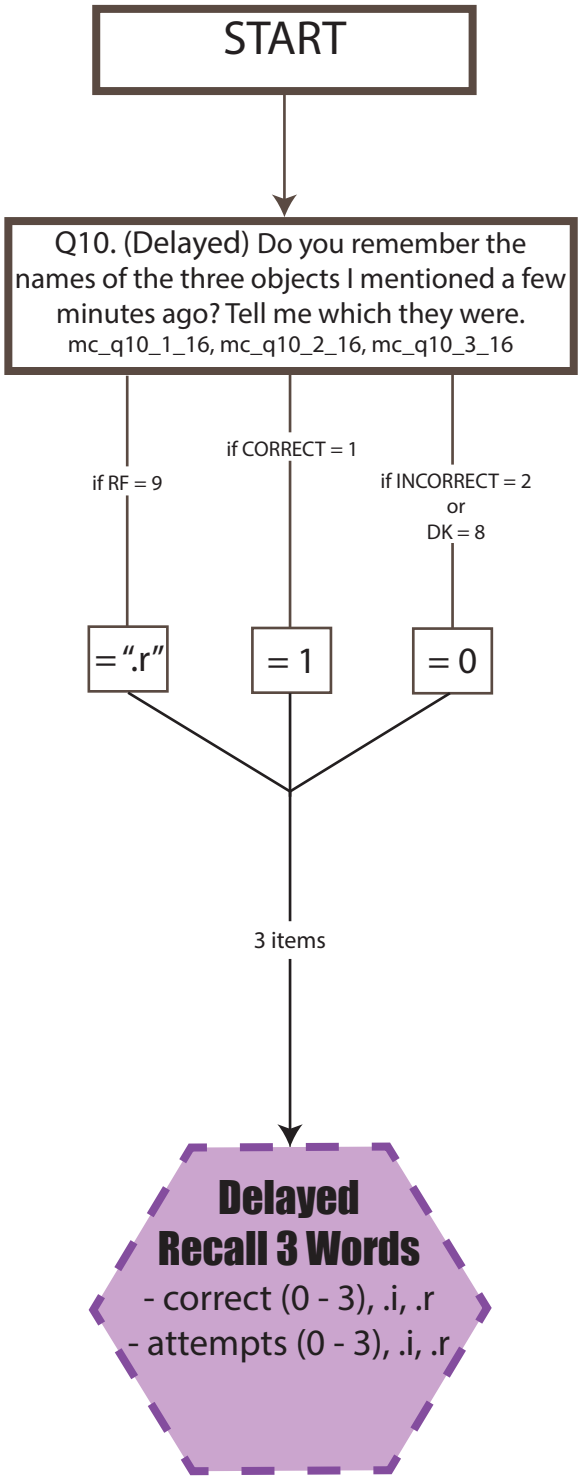


Correct = { Sum (correct out of 106 points if ≠ .c, .i, .l, .r)
.c if all items are .c .l if all items are .l
.i if all items are .i .r if all items are .r

Attempts = { Sum (maximum out of 106 points if ≠ .c, .i, .l, .r)
.c if all items are .c .l if all items are .l
.i if all items are .i .r if all items are .r

D3.1 DELAYED RECALL OF 3 WORDS SCORE FLOW CHART

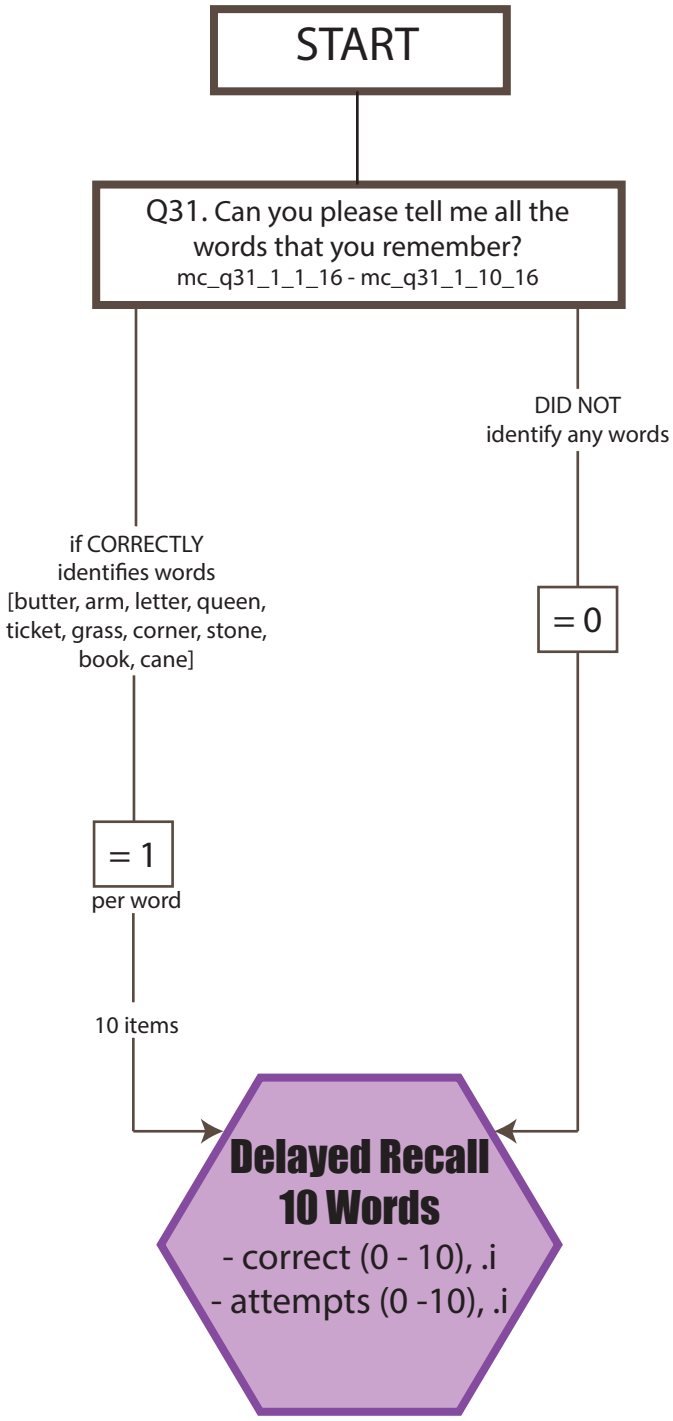
n = 2,042



NOTE: Dashed border means sentence / words are different from H_CAP

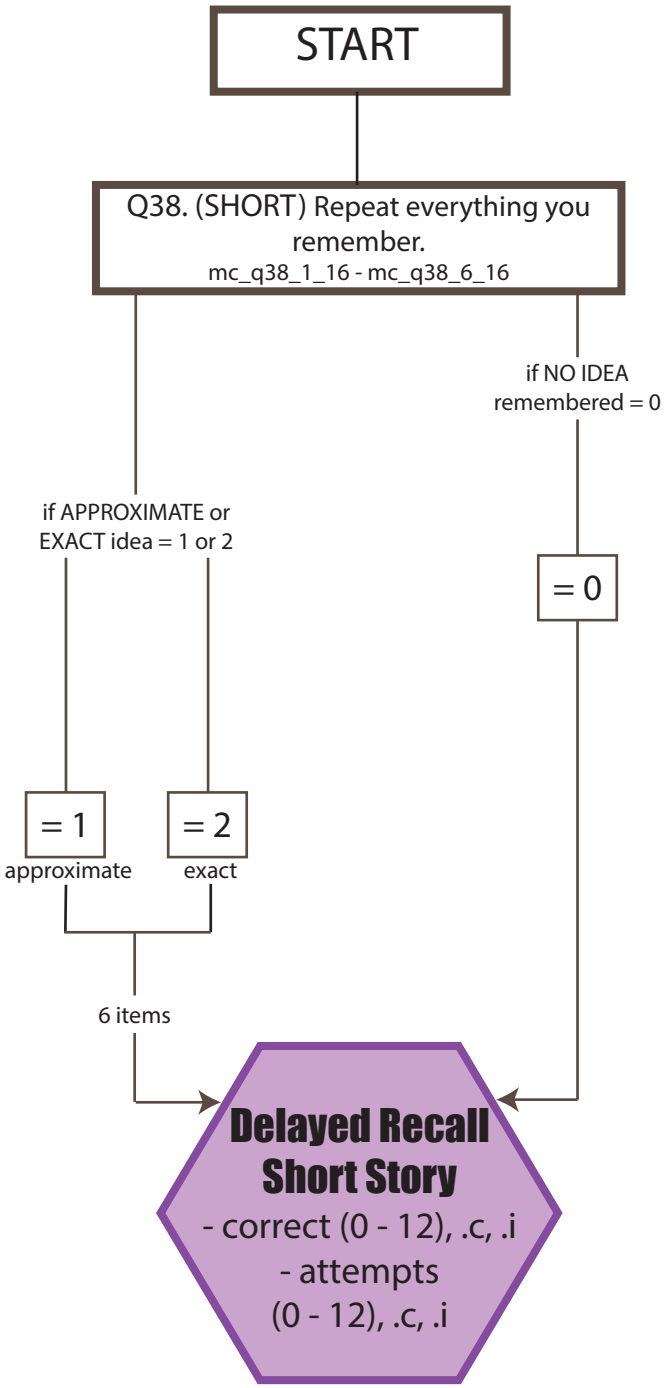
D3.2 DELAYED RECALL OF 10 WORDS SCORE FLOW CHART

n = 2,039



D3.3 DELAYED RECALL OF SHORT STORY SCORE FLOW CHART

n = 1,922



NOTE:

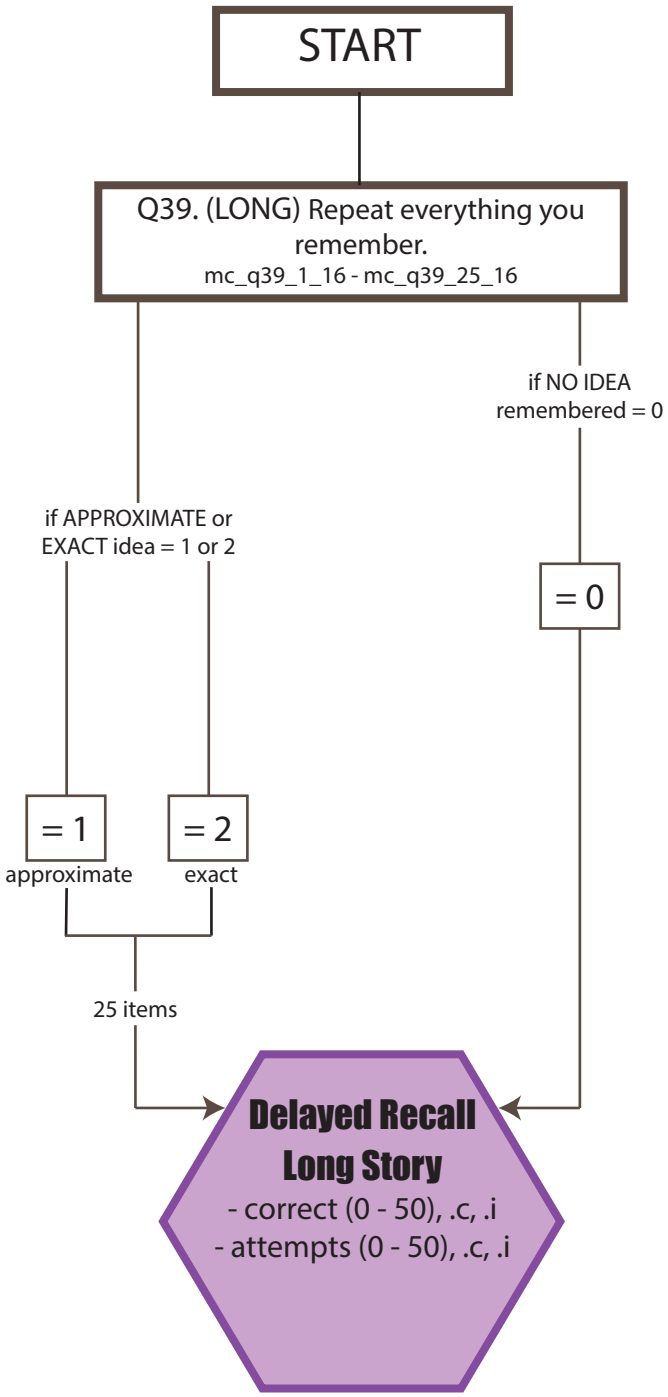
Two other variables were created to reflect scores as follows:

D3_t3_2 → 1 if exact or approximate, 0 if NO IDEA remembered

D3_t3_3 → 1 if exact, 0 if approximate or NO IDEA remembered

D3.4 DELAYED RECALL OF LONG STORY SCORE FLOW CHART

n = 1,922



NOTE:

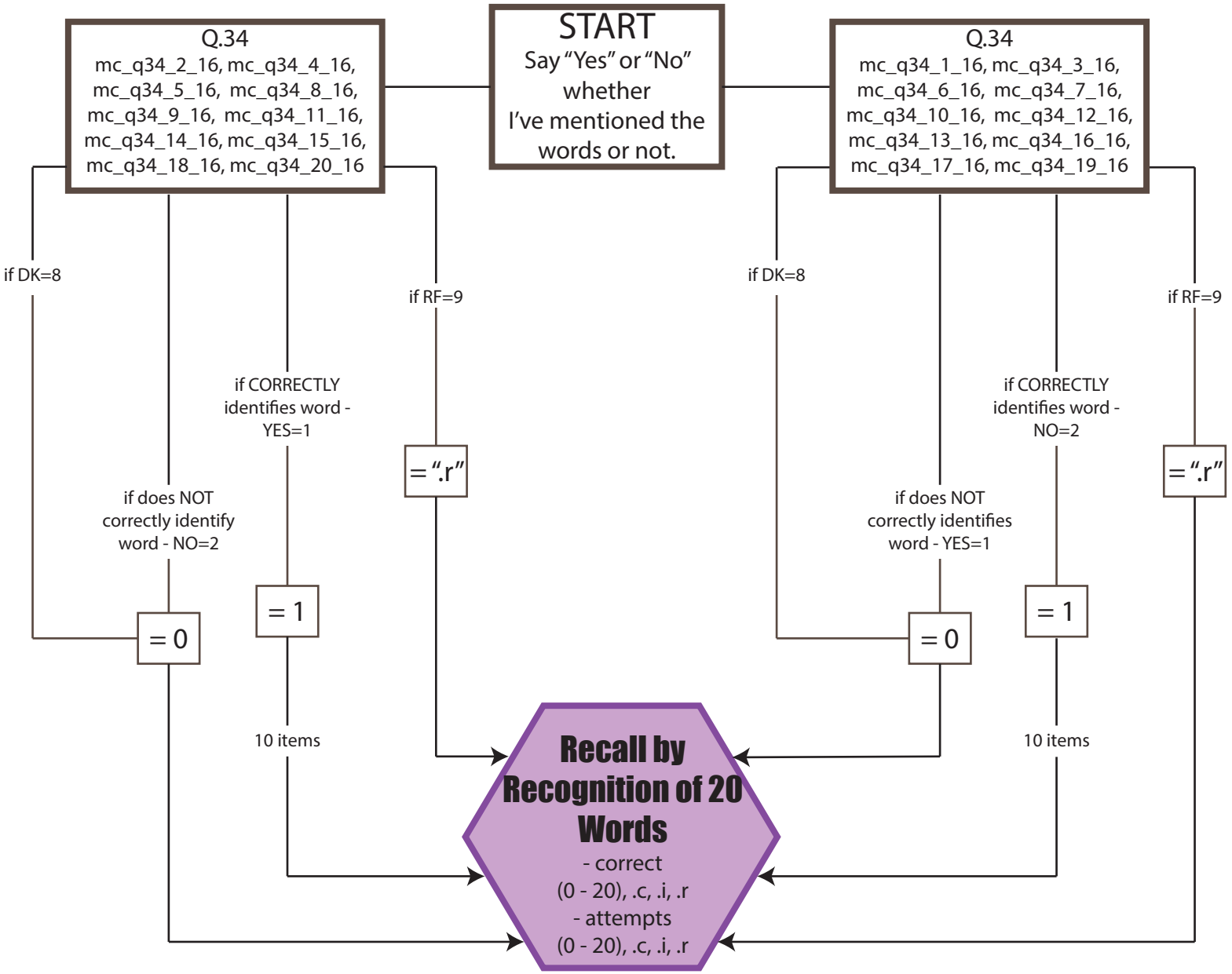
Two other variables were created to reflect scores as follows:

D3_t4_2 → 1 if exact or approximate, 0 if NO IDEA remembered

D3_t4_3 → 1 if exact, 0 if approximate or NO IDEA remembered

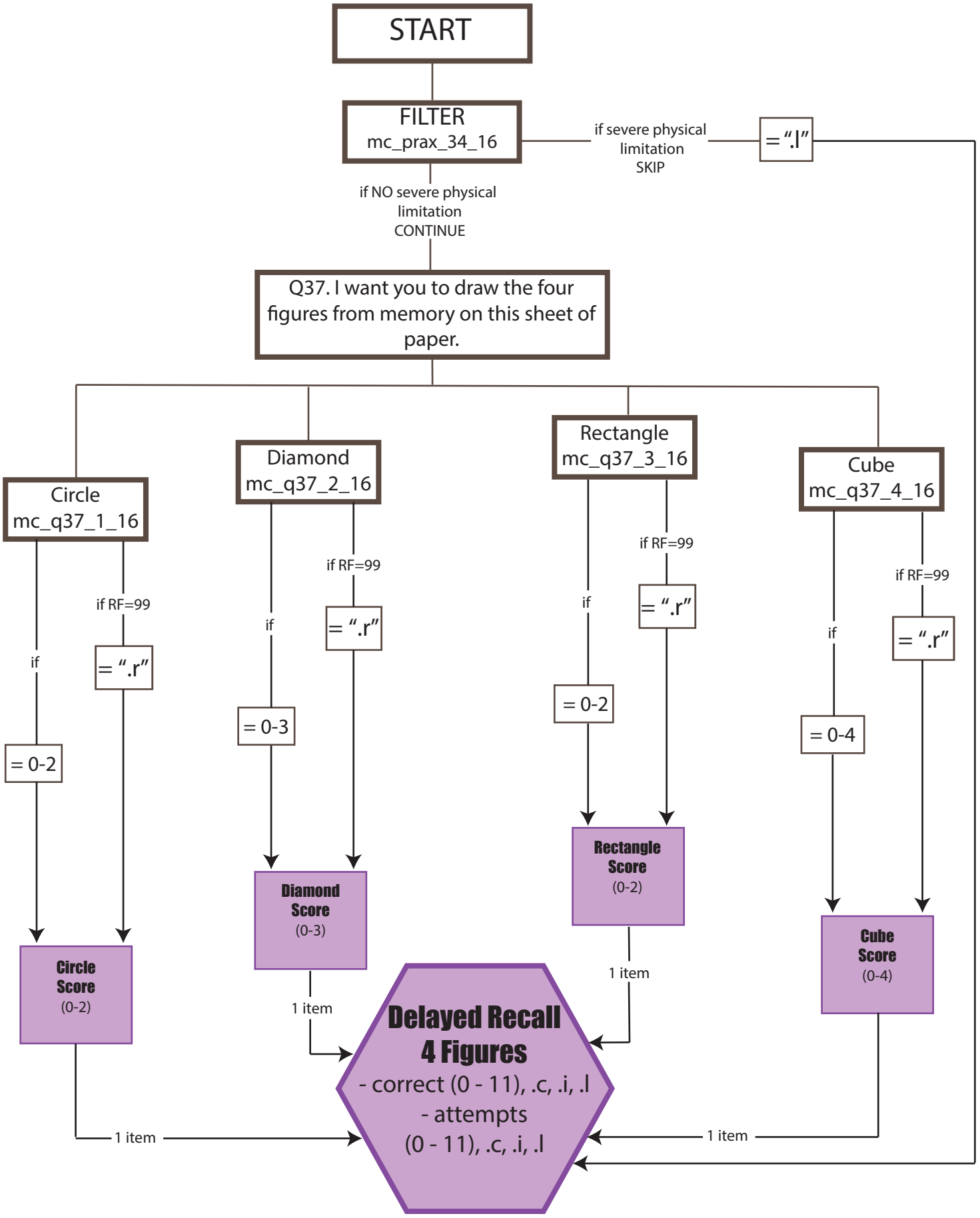
D3.5 RECALL BY RECOGNITION OF 20 WORDS SCORE FLOW CHART

n = 1,922



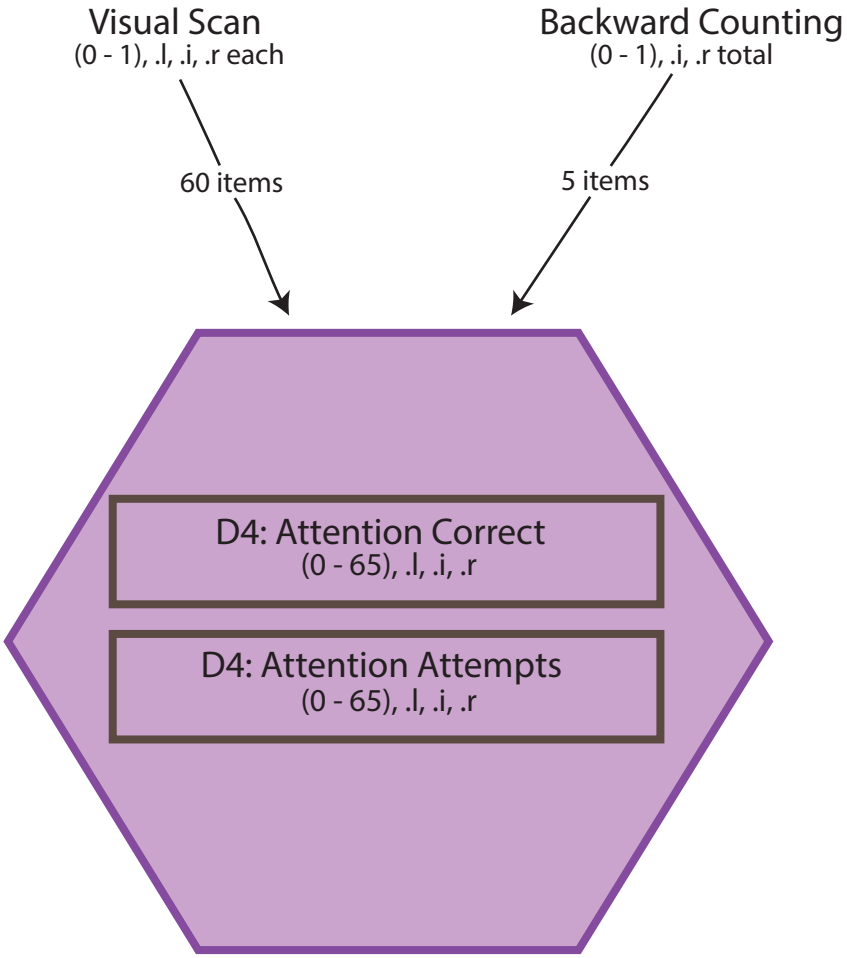
D3.6 DELAYED RECALL OF 4 FIGURES SCORE FLOW CHART

n = 1,869



4. ATTENTION

n = 2,042

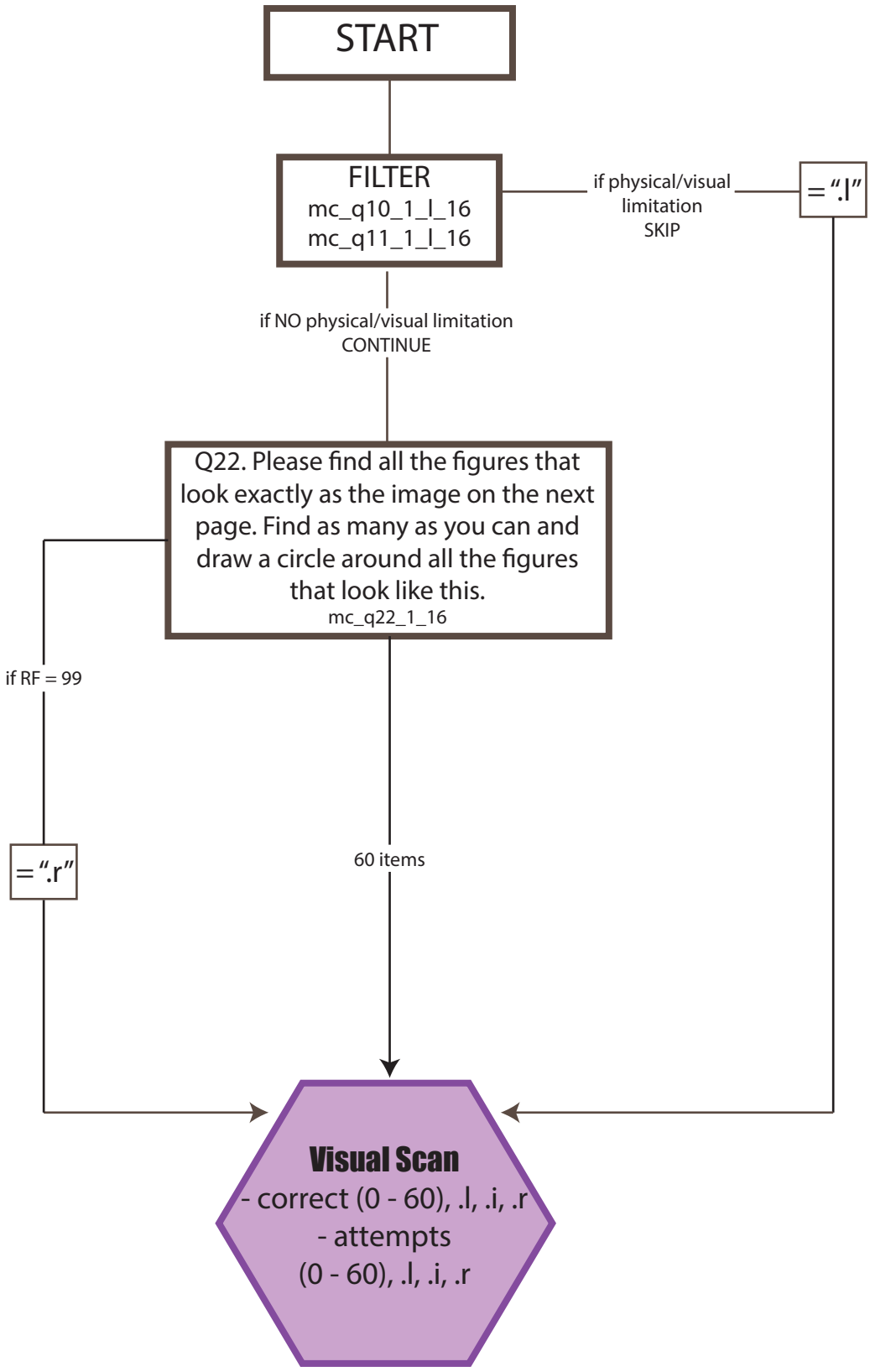


Correct = { Sum (correct out of 65 points if ≠ .l, .i, .r)
.l if all items are .l .r if all items are .r
.i if all items are .i

Attempts = { Sum (maximum out of 65 points if ≠ .l, .i, .r)
.l if all items are .l .r if all items are .r
.i if all items are .i

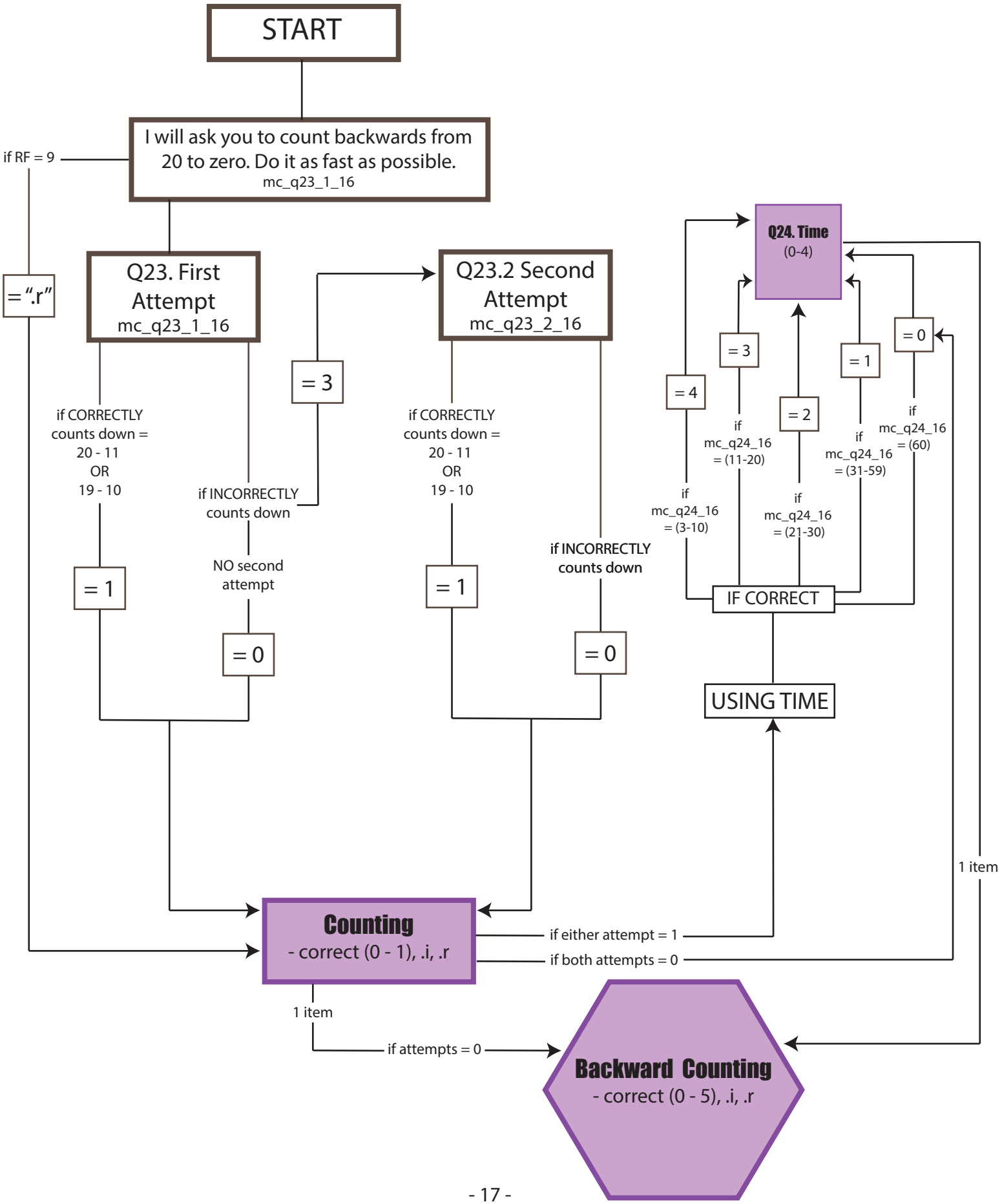
D4.1 VISUAL SCAN SCORE FLOW CHART

n = 2,039



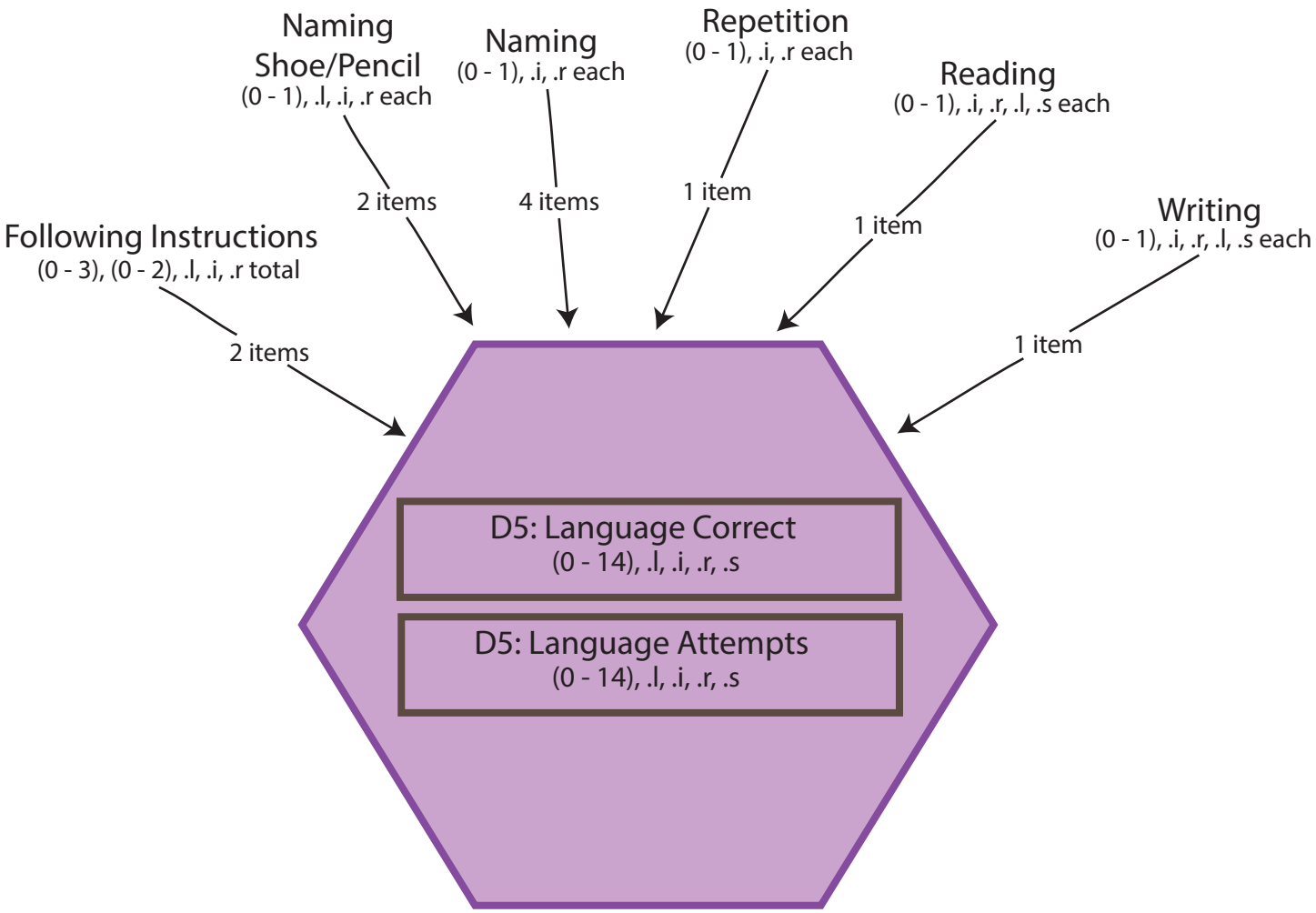
D4.2 BACKWARD COUNTING SCORE FLOW CHART

n = 2,039



5. LANGUAGE

n = 2,042

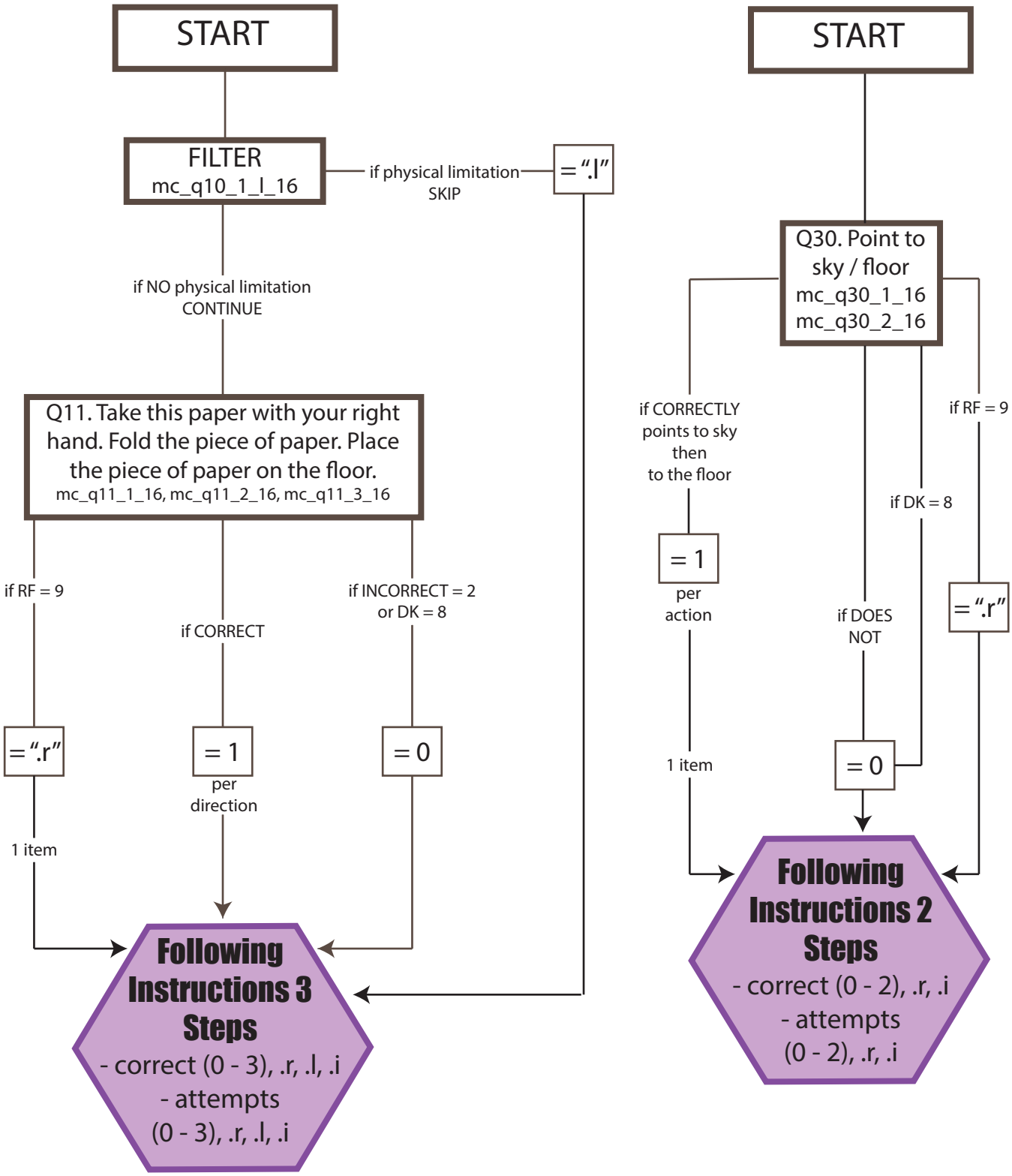


Correct = { Sum (correct out of 14 points if ≠ .l, .i, .r, .s)
.l if all items are .l .r if all items are .r
.i if all items are .i .s if all items are .s

Attempts = { Sum (maximum out of 14 points if ≠ .l, .i, .r, .s)
.l if all items are .l .r if all items are .r
.i if all items are .i .s if all items are .s

D5.1-2 FOLLOWING INSTRUCTIONS 3 STEPS/2 STEPS SCORE FLOW CHART

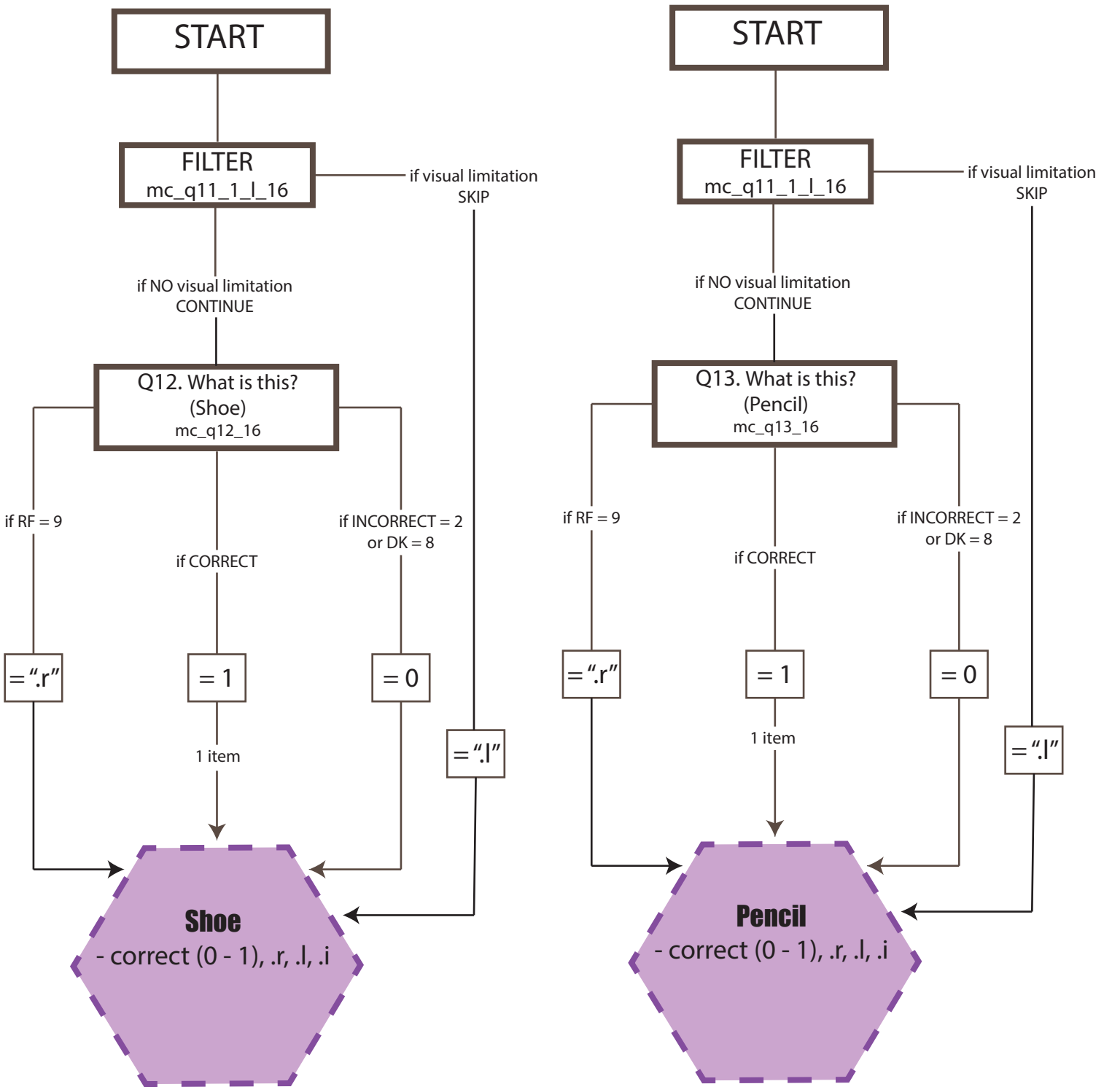
n = 2,042



NOTE : ".l" if physical limitation, ".r" if ALL are ".r"

D5.3-4 NAMING SHOE/PENCIL SCORE FLOW CHART

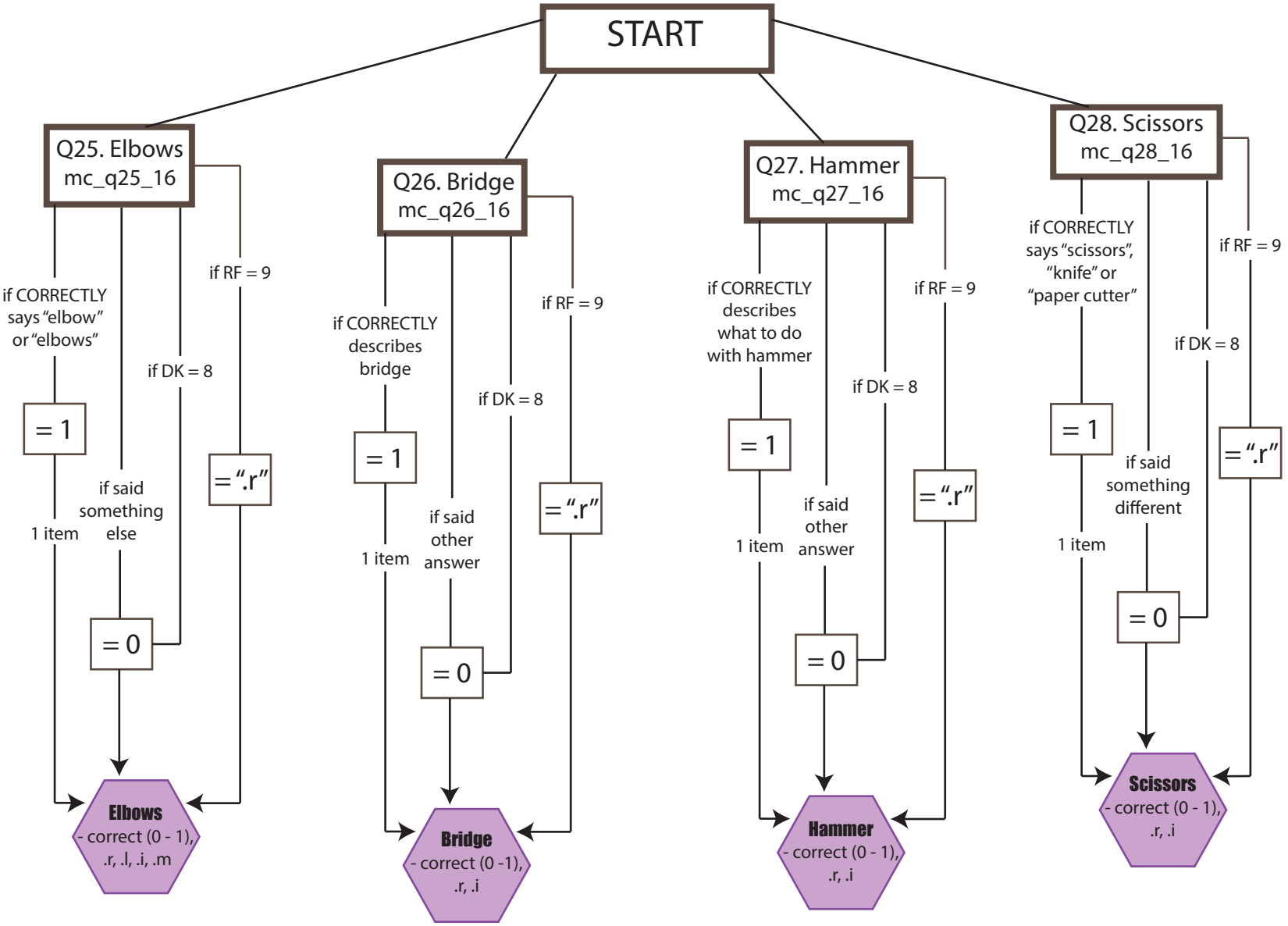
n = 2,042



NOTE: Dashed border means sentence / words are different from H_CAP

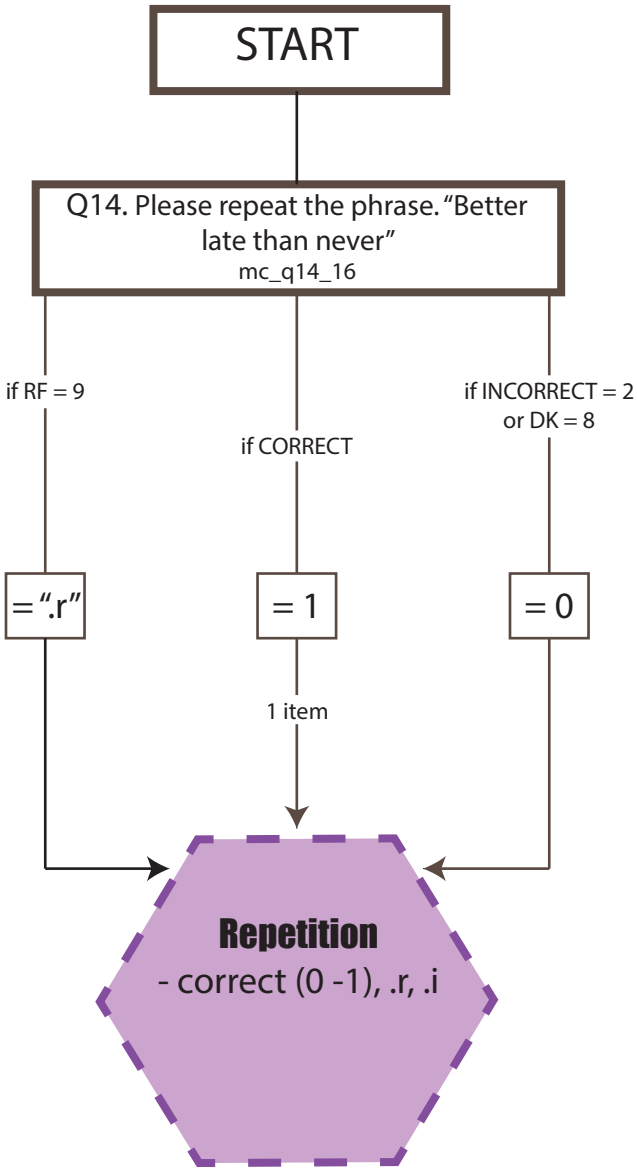
D5.5-8 NAMING (2)
SCORE FLOW CHART

n = 1,974



D5.9 REPETITION SCORE FLOW CHART

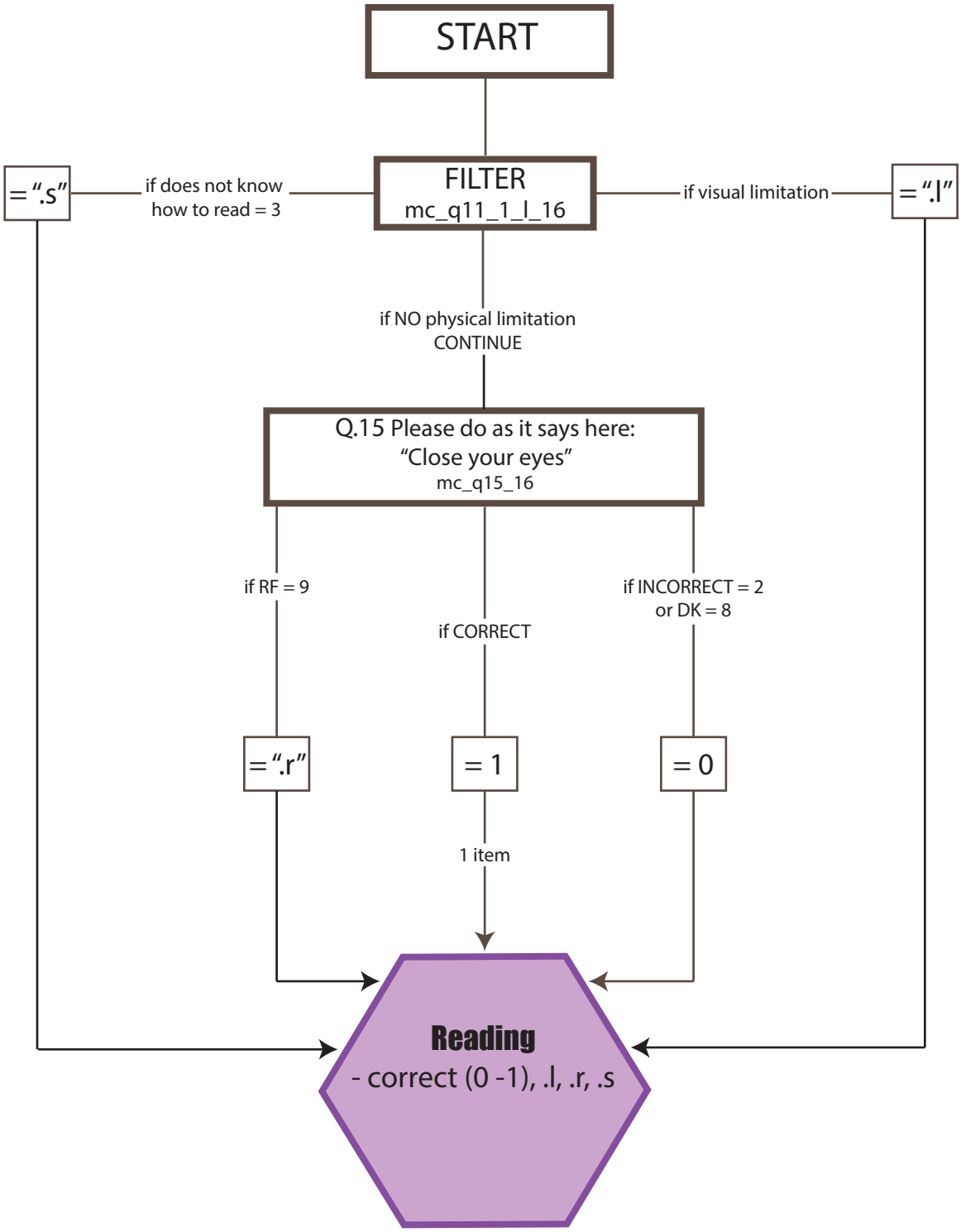
n = 2,042



NOTE: Dashed border means sentence / words are different from H_CAP

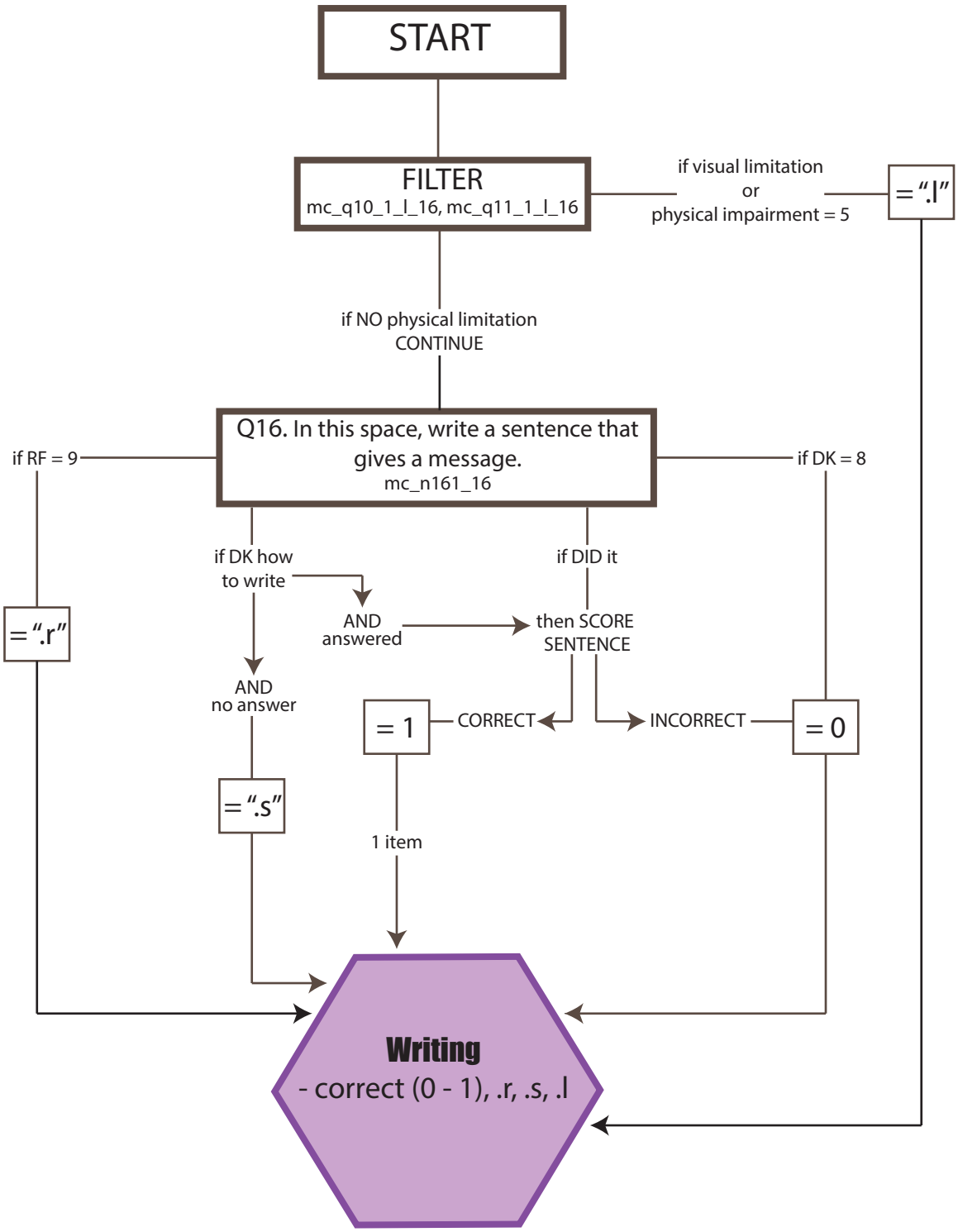
D5.10 READING SCORE FLOW CHART

n = 2,042



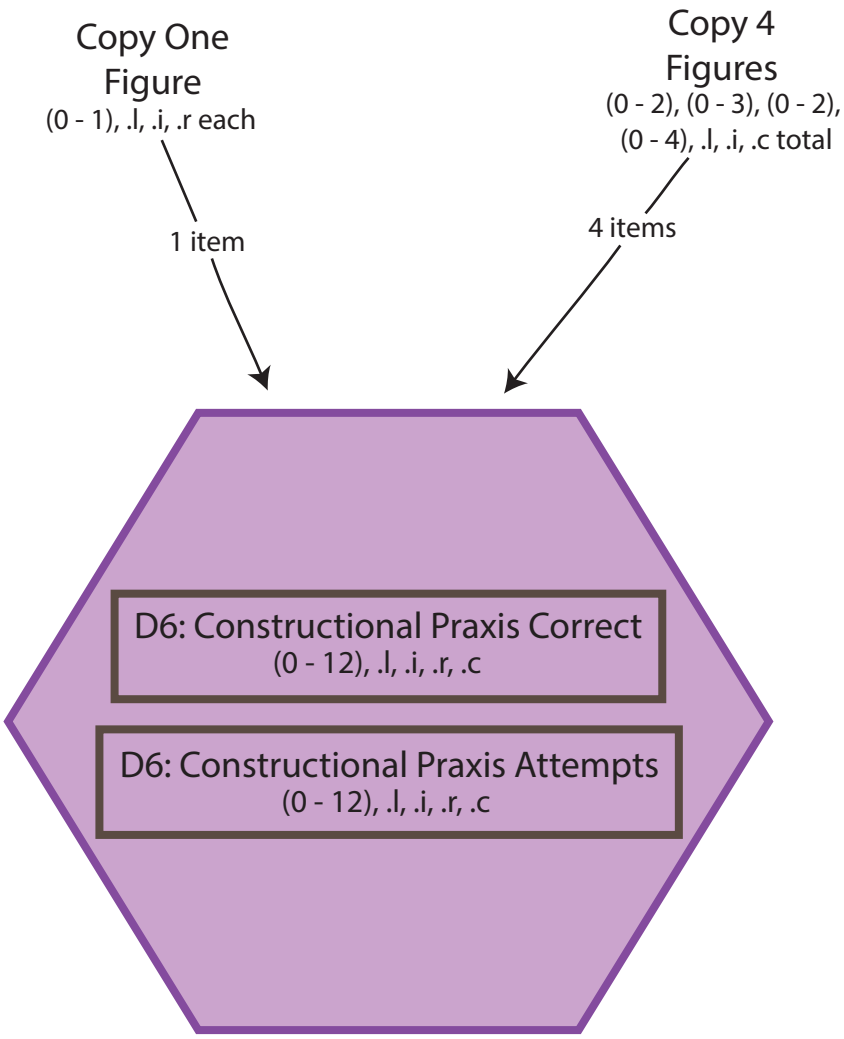
D5.11 WRITING SCORE FLOW CHART

n = 2,042



6. CONSTRUCTIONAL PRAXIS

n = 2,042

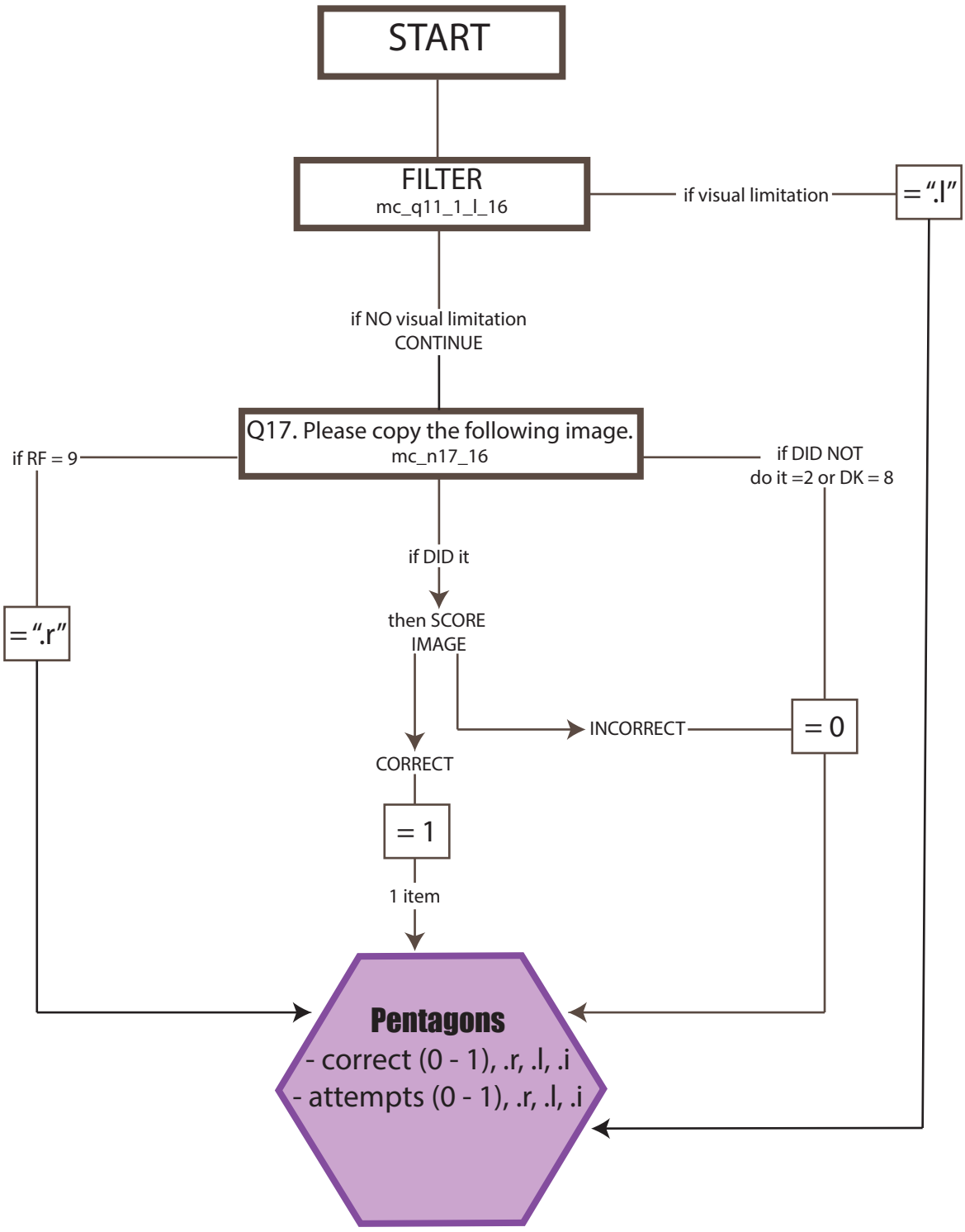


Correct = { Sum (correct out of 12 points if ≠ .l, .i, .r, .c)
.l if all items are .l .r if all items are .r
.i if all items are .i .c if all items are .c

Attempts = { Sum (maximum out of 12 points if ≠ .l, .i, .r, .c)
.l if all items are .l .r if all items are .r
.i if all items are .i .c if all items are .c

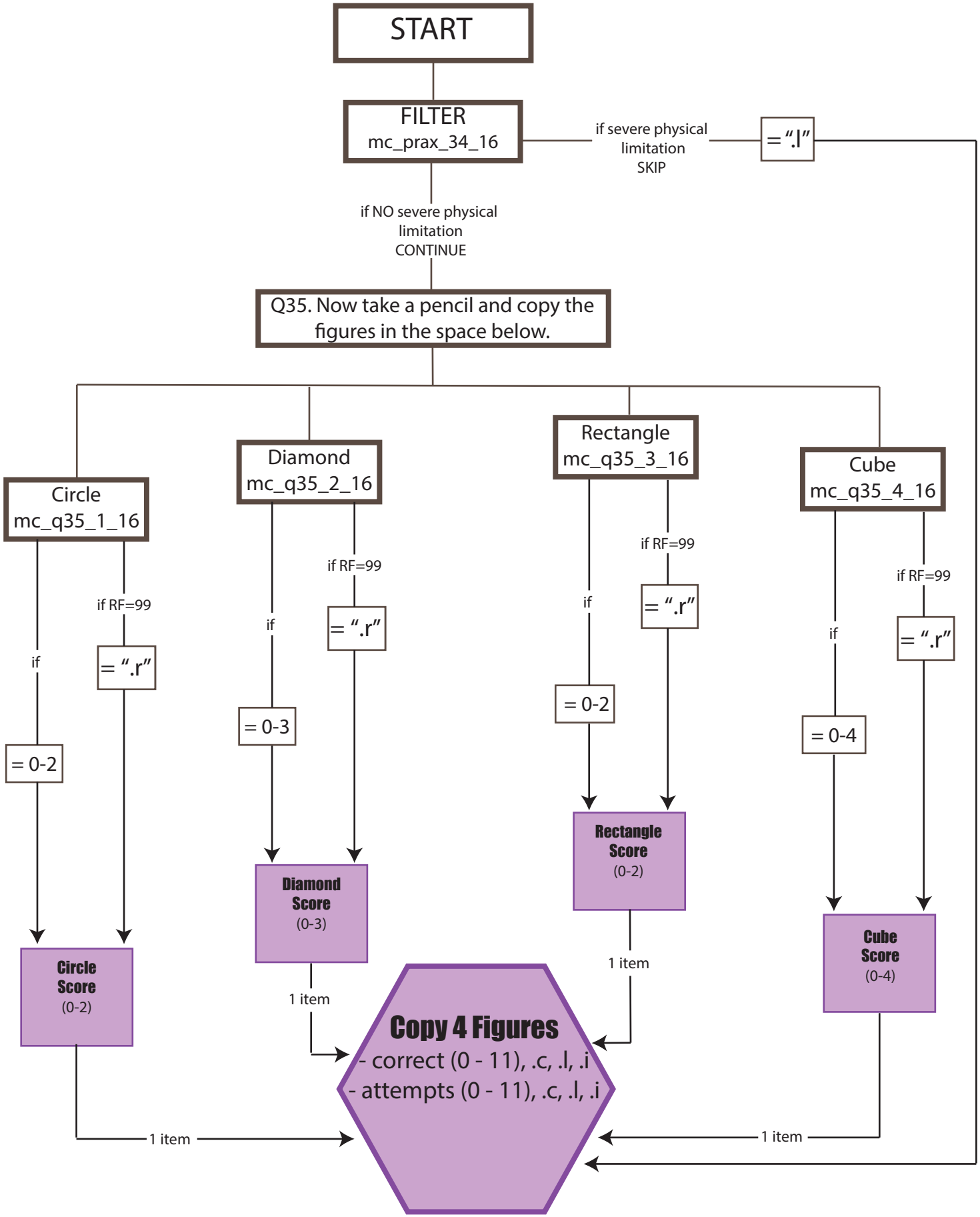
D6.1 COPY ONE FIGURE SCORE FLOW CHART

n = 2,042



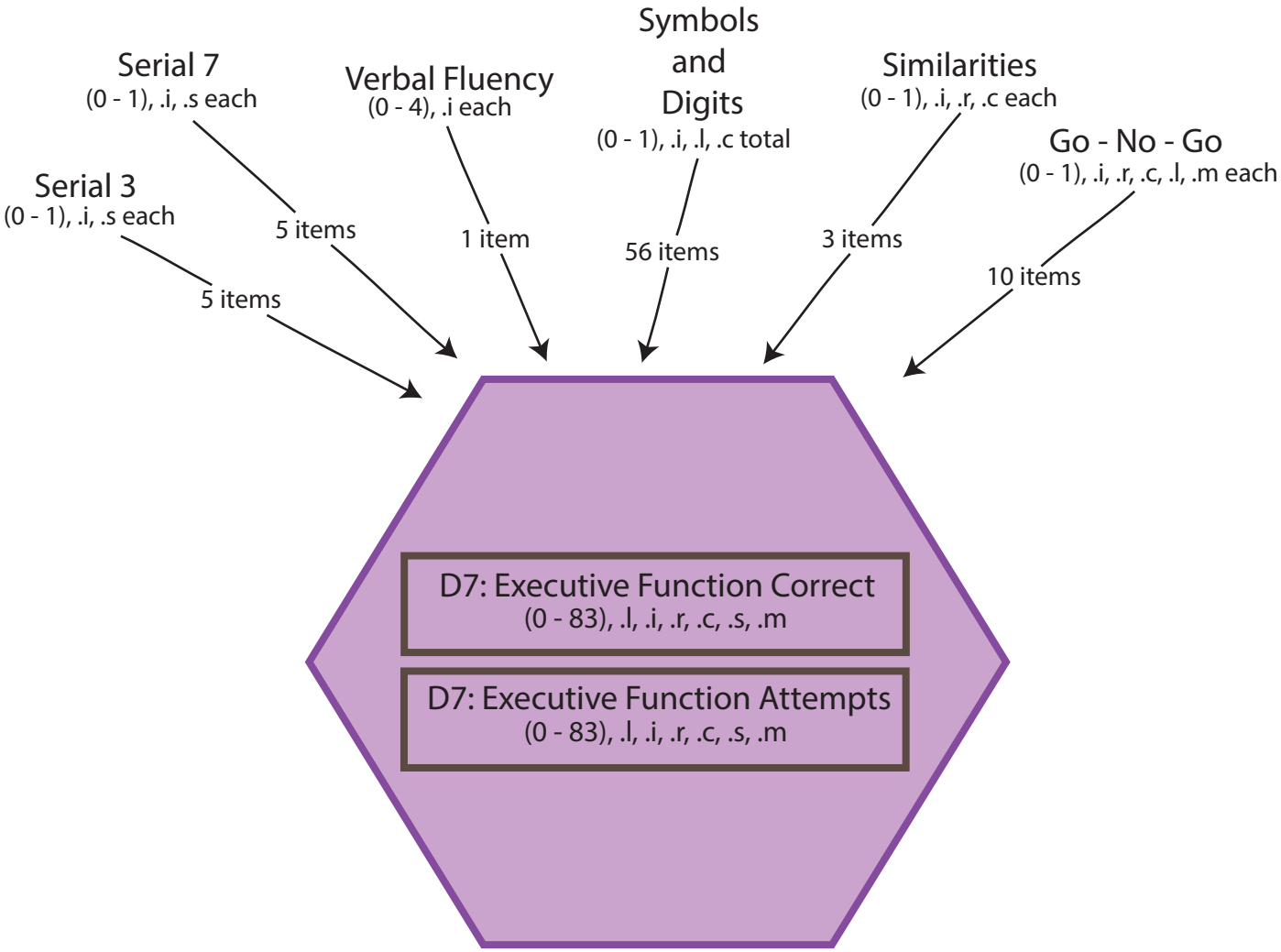
D6.2 COPY 4 FIGURES SCORE FLOW CHART

n = 1,878



7. EXECUTIVE FUNCTIONS

n = 2,042

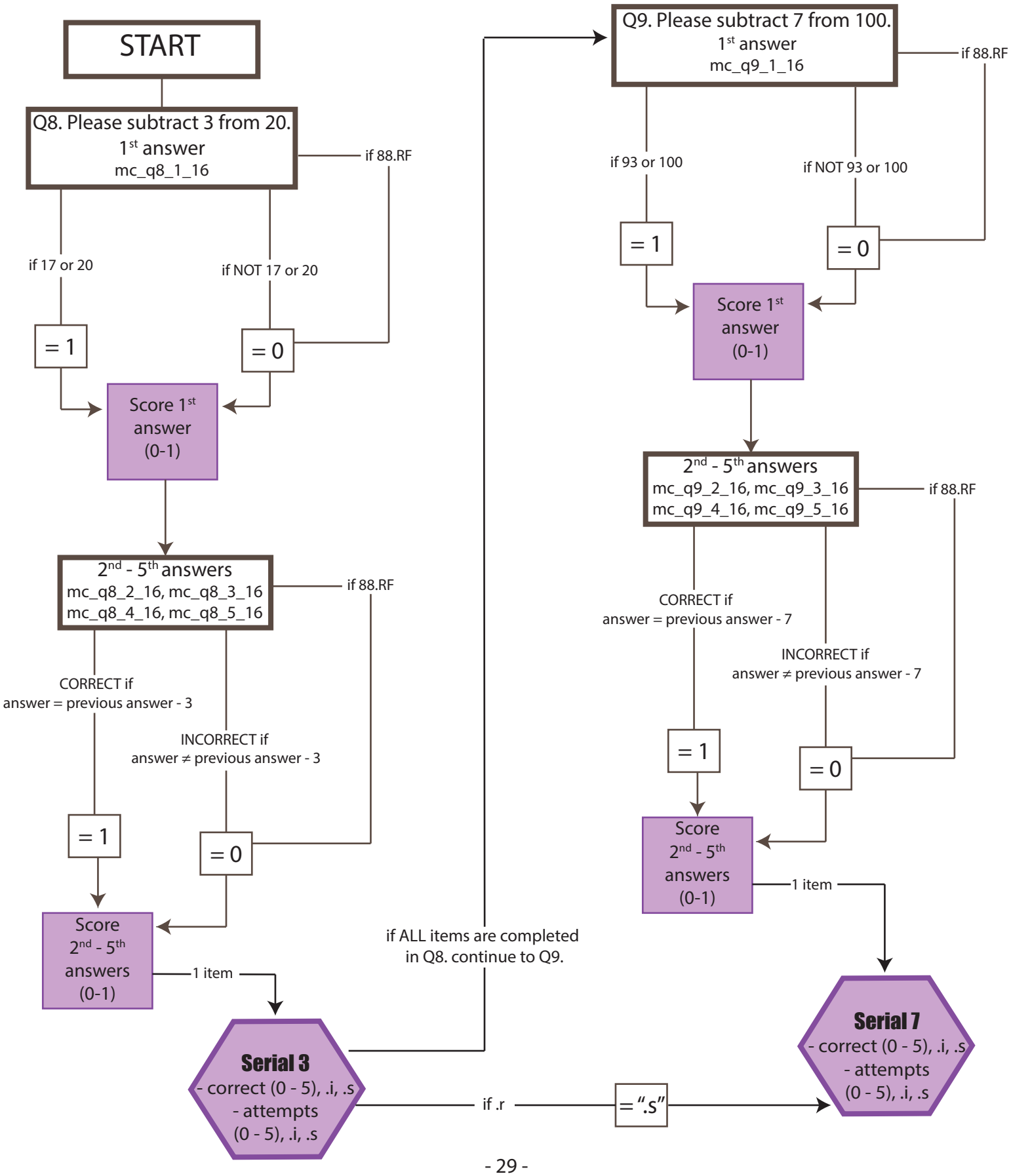


Correct = { Sum (correct out of 83 points if ≠ .l, .i, .r, .c, .s, .m)
.l if all items are .l .r if all items are .r .c if all items are .c
.i if all items are .i .s if all items are .s .m if all items are .m

Attempts = { Sum (maximum out of 83 points if ≠ .l, .i, .r, .c, .s, .m)
.l if all items are .l .r if all items are .r .c if all items are .c
.i if all items are .i .s if all items are .s .m if all items are .m

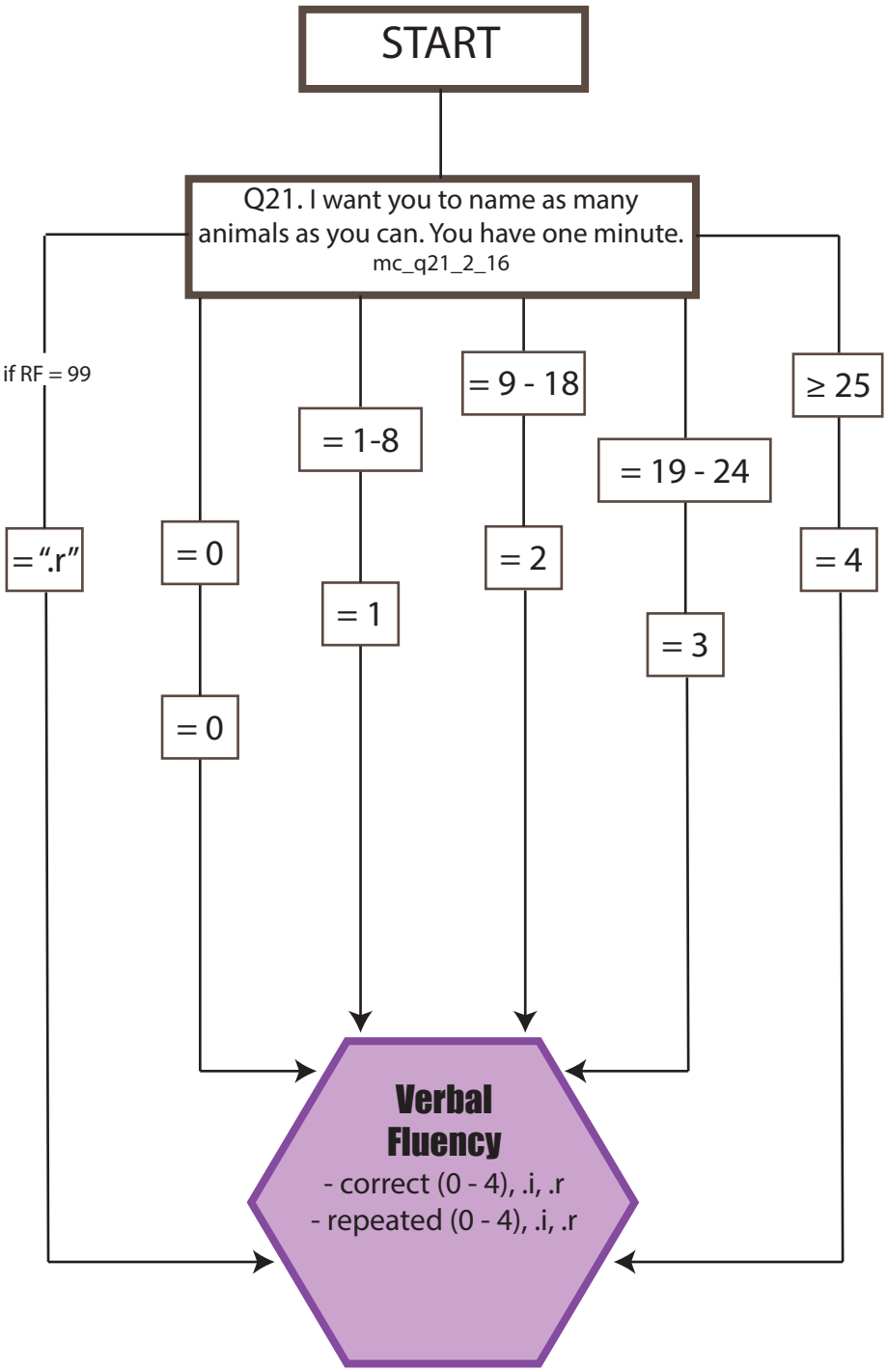
D7.1-2 SERIAL 3 & 7 SCORE FLOW CHART

n = 2,042



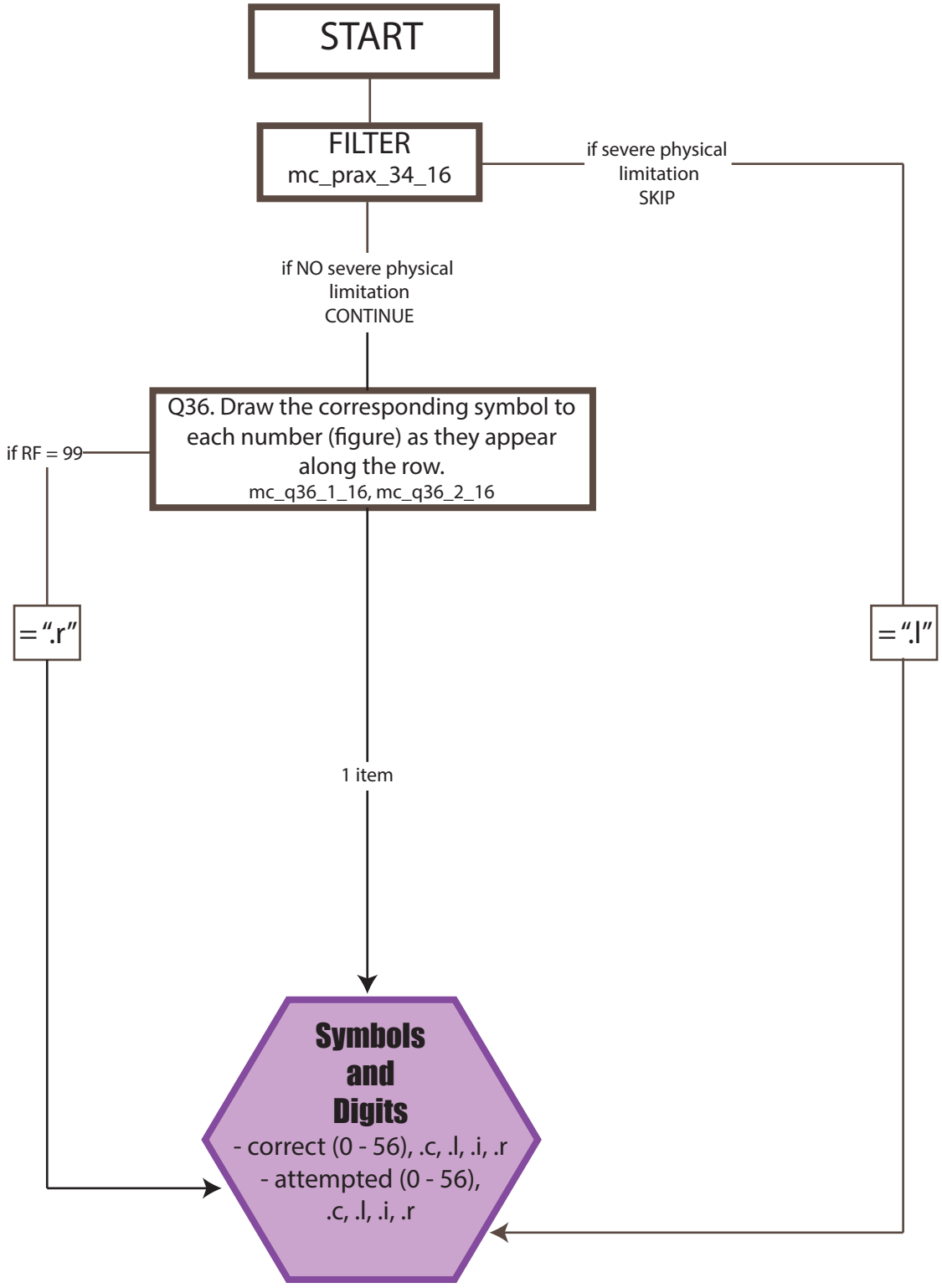
D7.3 VERBAL FLUENCY SCORE FLOW CHART

n = 2,039



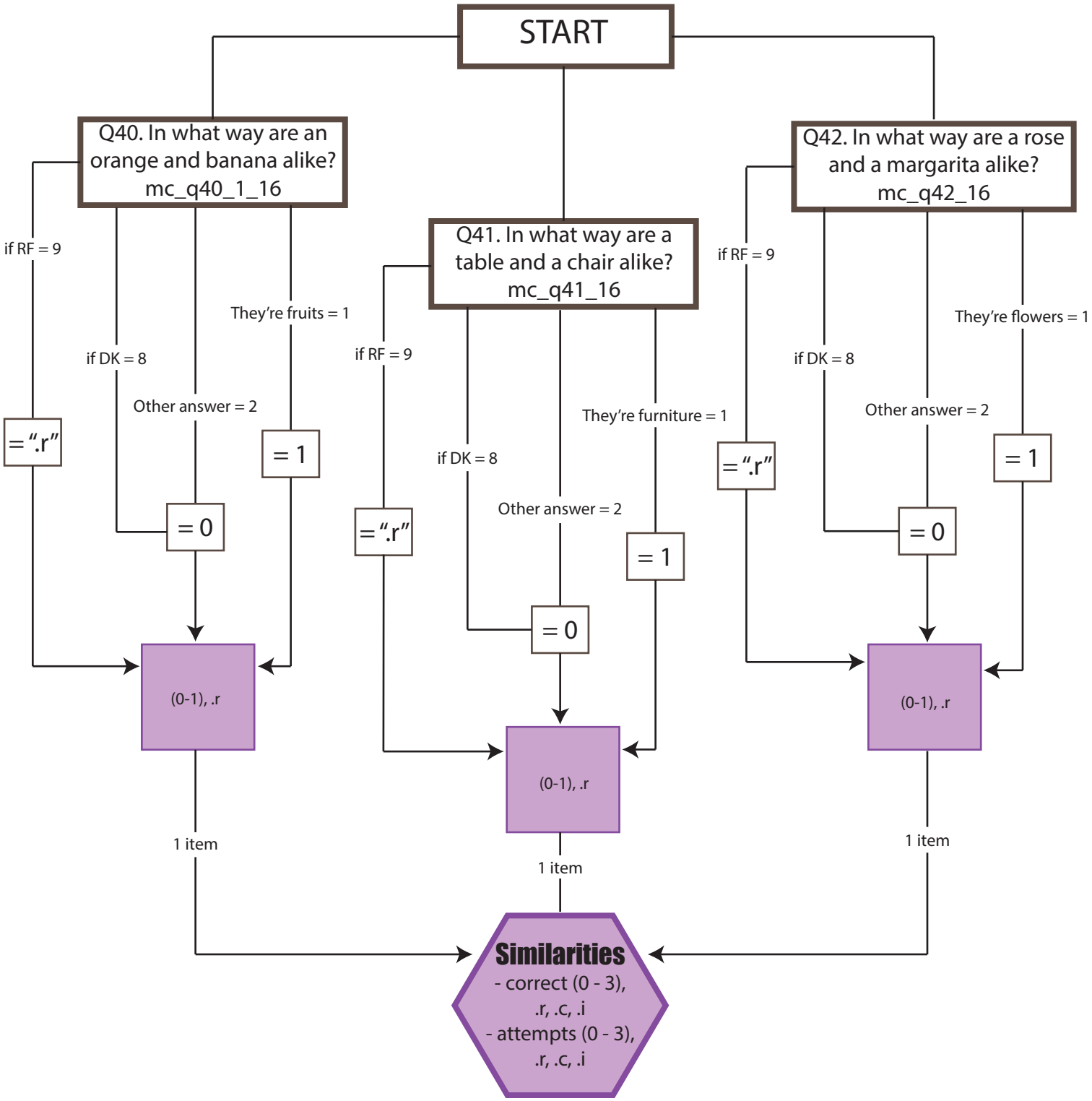
D7.4 SYMBOLS AND DIGITS SCORE FLOW CHART

n = 1,872



D7.5 SIMILARITIES SCORE FLOW CHART

n = 1,922



D7.6 GO - NO - GO SCORE FLOW CHART

n = 1,904