Marlene Kaminski

## Linguistic versus numerical processing

A study on the cost of switching between words and Arabic digits when reading aloud in Japanese as a foreign language


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#### Abstract

Sentences often require the manipulation of not just words but also Arabic digits. The present study aimed at discovering whether the subsequent reading aloud of a word stimulus followed by a number stimulus (and vice versa) had a switch cost, i.e., salient delays, in comparison to reading sequences of either only words or only numbers. For this, $n=18$ healthy, German learners of Japanese were asked to read aloud strings of Hiragana words and Arabic multidigit numbers. No statistically significant differences in mean response times were found when comparing sequences of words, sequences of numbers, sequences of numbers followed by a word, and sequences of words followed by a number. Instead, mean response times increased considerably for lower language proficiency levels of the participants. Mean response times further saw a statistically significant increase the higher the syllable lengths of the words and numerals. Implications are discussed in juxtaposition with existing theories on the cognitive processes necessary to read aloud words on the one hand and numbers on the other. For word-reading, these theories consist of the dual-route cascaded model (Coltheart 1978) and the parallel-distributed-processing model (Seidenberg \& McClelland 1989). For number-reading, the triple-code model (Dehaene 1992) and the model for multi-digit reading (Dotan \& Friedmann 2018) are explored.


switch cost | reading | Arabic digits | linguistic-numerical cognition | Japanese

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## List of abbreviations

## Abbreviation

a. Stimuli

N
W
b. Processing models

DRC model
PDP model
c. Brain regions

AG
IFG
IPS
MTG
PrG
SMG
STG
d. Linguistic terms

CAUS
GEN
HON
NMLZ
e. Miscellaneous

IPA
RT
SNARC SPSS

Meaning
number
word

> dual-route cascaded model
> parallel-distributed-processing model
angular gyrus
inferior frontal gyrus
intraparietal sulcus
middle temporal gyrus
precentral gyrus
supramarginal gyrus
superior temporal gyrus
causative
genitive
honorific
nominaliser

International Phonetic Alphabet
response time
spatial-numerical association of response codes
Statistical Package for the Social Sciences

## Jefferson (2004) transcription system

## Notation Example

(0.0)
(.) good (.) morning

- good-
: goo:: : d
$=\quad$ good=morning
${ }^{\circ}$ word ${ }^{\circ}$ good morning ${ }^{\circ}$
$\uparrow \quad$ good mor个ning
$\downarrow \quad$ good mor $\downarrow$ ning


## Meaning

break in seconds
short break (<0.1 seconds)
cut-off
extension of the previous sound
(more colons equal longer extensions)
no break
soft speech
rising intonation
falling intonation

The notation follows Jefferson (2004: 24-31).

## 1．Introduction

Linguistic and numerical signs often coexist．This is true for mathematics，where letters can function as variables in formulae，as seen in example（1）．It is also true for speech and text， where word strings might be interrupted by the mention of a date，a price，or quantities in general，as seen in example（2）．
（1）$a^{2}+2 a b+b^{2}=(a+b)^{2}$
（2）Back in 1970，I only had to pay 50 pence for 3 scoops of ice cream！

For healthy readers proficient in the English language，a sentence like the one illustrated in（2） should pose no problem for understanding and reading aloud．This，however，is not self－ explanatory：how，if at all，can numbers be easily read alongside words？Unlike the alphabetic nature of English words，numbers presented in Arabic digits do not give any phonetic information．A single digit equals an entire number word（ $1=$＇one＇）and multiple digits together make up entire phrases（1970＝＇nineteen seventy＇，or in other cases＇one thousand nine hundred and seventy＇）without spelling out the pronunciation．

The lack of phonetic information in Arabic digits is a ubiquitous aspect in languages using logographic scripts，＂where characters represent units of meaning＂（Dylman \＆Kikutani 2018：504）rather than sound．For instance，in the Mandarin Chinese word 自信 zixxin＇self－ confidence＇，none of the individual characters or strokes give information on phonetic content （Huang \＆Shi 2016：7－10）．${ }^{1}$ The compound 自信 zìxin＇self－confidence＇can instead be semantically split up into the characters 自 zì meaning＇self＇and 信 xìn meaning＇trust＇（Jiang 2016：506－507）．However，as the entire script relies more readily on semantic rather than phonetic parsing（Kess \＆Miyamoto 1999：50），Mandarin Chinese is not quite comparable to the constant switch of alphabetic to numerical characters presented in example（2）above．In－ sentence switches are instead pervasive for Japanese inasmuch as it is a language that uses and combines a logographic script（the Chinese characters Kanji）as well as two phonetic scripts（the syllabaries Hiragana and Katakana）potentially all within a single sentence． Through this system，some words，such as jishin＇self－confidence＇，can be represented in three different ways：自信（Kanji），じしん（Hiragana），ジシン（Katakana）（Kess \＆Miyamoto 1999： 199）．There has been research on delayed responses when switching between each of these scripts in comparison to staying within the same script．The expectation here was that a script switch had a＂cost＂，i．e．，considerably longer delays between two words than when there is

[^0]no script switch (e.g., Kess \& Miyamoto 1999: 105; Shafiullah \& Monsell 1999; Dylman \& Kikutani 2018).

In this work, I aim at answering the question of whether there is a switch cost for switching between the reading aloud of words and Arabic digits, thus expanding the research on switch cost into linguistic-numerical cognition. Despite the fact that both words and numbers require the manipulation of socially invented, complex systems of signs (Carreiras et al. 2015), there are different models on what cognitive processes take place in order to read words versus numbers aloud. In fact, even just for words alone, researchers have not yet come to a consensus on which model is the most accurate in describing the complex brain mechanisms involved (Rayner \& Reichle 2010: 788). Therefore, after defining numerical terminology in §2, only the most prominent and most thorough models will be outlined: for word-reading, the dual-route cascaded model by Coltheart (1978) will be described in §3.1.1 and the parallel-distributed-processing model by Seidenberg \& McClelland (1989) in §3.1.2, while for number-reading, the triple-code model by Dehaene (1992) will be described in §3.2.1 and the model for multi-digit reading by Dotan \& Friedmann (2018) in §3.2.2.

Since there are different models for word-reading on the one hand and number-reading on the other hand, it is expected that different processes with different cognitive frameworks are activated for word-reading versus number-reading, and that switching between these two different cognitive frameworks therefore has a switch cost. This hypothesis, along with multiple sub-hypotheses (§4), was tested by means of a study, in which $n=18$ German learners of Japanese had to read aloud strings of Hiragana words and Arabic multi-digit numbers. The study's methodology will be described in §5 and its results in §6. In §7, the results will be discussed in juxtaposition with all hypotheses as well as the different reading models proposed for literacy and numeracy.

## 2. Definitions of numerical terminology

Much like the term word is easy to grasp intuitively but difficult for linguists to comprehensively define (Dixon \& Airkhenval'd 2002: 1-10), the term number, too, requires nuanced explanations to disambiguate its multiple facets. Numbers always denote a specific quantity, such as $\cdots$ (three entities). There are many ways to represent this. For example, quantity can be represented through "fingers, notches on a stick, [or] knots on ancient quipu Inca strings" (Dehaene 1992: 3). In language, numbers occur in the form of letter strings, such as <three>, or in the form of sound sequences, such as $/ \theta$ ri:/. It is also possible to represent numbers symbolically. This may be done with concrete notations, where every single counted
entity is depicted with an added symbol. For instance, the number three is written as three lines ||| in Egyptian hieroglyphs (Dehaene 1992: 3). The three dots $\bullet \bullet$ used as an indication of quantity above also fall under this category. Numbers can further be represented symbolically through additive notations. Here, only a few central quantities need their own symbols, which are then placed back-to-back to represent any number in question. For example, the number 23 may be written only with the symbols 1 and 10 as 1010111 so that 10 plus 10 plus 1 plus 1 plus 1 equals a quantity of 23 . Considering that this notational system is based on addition, symbol order is not of concern, inasmuch as even a depiction of 1101101 would lead to a sum of 23 (Dehaene 1992: 3). Symbol order does matter, however, for the positional notation of Arabic digits. Even though only ten symbols (0-9) are needed to create infinitely long number strings, the position of each number is pivotal: 23 is not the same as 32 , because the prior (left) slot of the number is defined to be for tens, while the latter (right) slot is defined to be for units (Dehaene 1992: 3-4). Note that the explanations on both additive notations as well as Arabic digits above are formed with decimal systems in mind since these are the standard for the vast majority of number systems. In decimal systems, also called base-10 systems, the number 10 is used as the base for symbolic notation. However, 10 is not considered a crucial number in all languages. Symbolic representations of numbers can instead also be based on powers of, for example, 2, 20, or 60 (Dehaene 1992: 3; Hurford 1999: 15).

Symbolic notations of numbers can moreover be articulated. When Arabic multi-digit numbers are read aloud, their hybrid multiplicative-additive nature is revealed. Hybrid multiplicative-additive verbalisations may introduce a new quantity to any existing number word by which this number word must be multiplied. This stands in contrast to verbalisations of the additive systems mentioned above. To explain by example, the number 200 is not enunciated as hundred hundred (additive system), but as two hundred, with the number word hundred having to be multiplied by the quantity of two. The longer the number, the more complex the number word's syntax becomes (Dehaene 1992: 3-4). This is despite, or perhaps due to the fact that number words in simple hybrid multiplicative-additive systems only consist of two parts. Namely, the "real" number words for the digits 1-9, and so-called multiplier words, such as ten (in English realised as -teen or -ty), hundred, thousand, etc. (Dehaene 1992: 4). The importance of individual multiplier words is not equal across different languages: for instance, triplet systems, such as German and English, focus on the multiplier word thousand in number word formation of high-digit numbers, while myriad systems, such as Chinese and Japanese, focus on the multiplier word ten-thousand (Dotan \& Friedmann 2018: 23-24; more on which in §5.3).

In summary, the term number essentially stands for the quantity of a number (e.g., $\cdots \bullet$ ), its language-dependent representations (i.e., words and sounds), and culture-dependent symbolic representations (e.g., 3). It is also affected by groupings of what is considered a crucial number (e.g., base-10, base-20, etc.; thousand versus ten-thousand). In this work, the term number mainly refers to the Arabic digits from 0-9 as single-digit numbers, such as 3 , or combined in any way to multi-digit numbers, such as 23 . Note that some authors (e.g., Metcalfe \& Campbell 2008; Cappelletti 2015; Holloway \& Ansari 2015) refer to Arabic digits as Arabic numerals. This is avoided here since linguistics uses the term numeral as a synonym for number words. In this work, too, number word and numeral will be used interchangeably. Two other terms that will be treated as equal are quantity and magnitude. Further, the notation (number) word is shorthand to refer to both "normal" words and number words simultaneously.

## 3. Processing linguistic and numerical signs

Even though they commonly coexist in sentences, words and numbers are two separate sets of culturally produced, complex systems of signs (Carreiras et al. 2015). There are different models on the cognitive processes involved in reading aloud words on the one hand and numbers on the other hand.

### 3.1 Models for word-processing

Reading aloud words is a complex procedure involving an accumulation of "many fundamental cognitive processes" (Rayner \& Reichle 2010: 787). Researchers have tried to develop a model suited for accurately describing these for more than a hundred years (Coltheart et al. 2001: 207). Today, there are two different models that stand out as the most widely researched: the dual-route cascaded (DRC) model by Coltheart (1978), and the parallel-distributed-processing (PDP) model by Seidenberg \& McClelland (1989) (Humphreys \& Riddoch 2005: 359; Rayner \& Reichle 2010: 788). Both also have computational versions which try to algorithmically predict behaviour of both healthy and impaired readers (Coltheart et al. 1993: 590; Rayner \& Reichle 2010: 788). The DRC model and the PDP model are not, however, the only reading models by any measure:

Numerous models of word identification have been proposed during the last 30 years [alone], including the Interactive-Activation (McClelland \& Rumelhart 1981), Activation-Verification (Paap et al. 1982), Multiple-Levels (Norris 1994), Multiple Read-Out (Grainger \& Jacobs 1996), Multiple-Trace Memory (Ans et al. 1998), Connectionist Dual-Process (Zorzi et al. 1998), and Bayesian Reader (Norris 2006) models.
(Rayner \& Reichle 2010: 788, footnote citation exchanged for in-text citation)

All models above, including the DRC and PDP model, have at least one aspect in common. Namely, they only describe processes involved in reading single words rather than taking into consideration the strategies necessary to read entire syntactic constructions. For these, there are yet more extensive models (Rayner \& Reichle 2010: 788). In the context of this work, it suffices to focus on non-syntactic models inasmuch as the present study did not require participants to parse word phrases or sentences. While the DRC model (§3.1.1) and the PDP model (§3.1.2) deal with the same task of reading single words aloud, they have contradictory ideas on the cognitive mechanisms involved in doing so (Rayner \& Reichle 2010: 788).

### 3.1.1 Dual-route cascaded model

The beginnings of the dual-route theory trace back to 1973 , when it was first outlined by Forster \& Chambers (1973) and Marshall \& Newcombe (1973) (Pritchard et al. 2012: 1268). Arguably the most prominent, however, is the dual-route cascaded (DRC) model by Coltheart (1978) and its readjustments over the last four decades (Humphreys \& Riddoch 2005: 359). The DRC model proposes that the phonological form of a written word can be retrieved via two distinct processes, or routes: the lexical route and the non-lexical route.

### 3.1.1.1 Lexical route

When a word is read aloud by means of the lexical route, also called direct route, its phonological form is directly accessed through a mental dictionary. In this dictionary, the reader has an entry for both the orthography and the phonology of every word they have learnt. Therefore, reading involves visually recognising the string of letters that constitute a word as a known entity, finding a matching entry in the mental dictionary, and enunciating the phonological form stored there (Coltheart et al. 1993: 589; Coltheart 2005: 9). By opening the mental dictionary, readers also have immediate access to the semantics of the word they are reading (Luzzatti \& Whitaker 2006: 21). Further, the lexical route is said to activate more automatically (Paap \& Noel 1991: 15) and to be faster than the non-lexical route (Luzzatti \& Whitaker 2006: 21).

### 3.1.1.2 Non-lexical route

When reading aloud unknown but real words, or when reading aloud pseudowords (i.e., any letter string, such as *phlonk, that could be, phonotactically speaking, a word in the language in question), the mental dictionary is not accessed, because there is no lexical entry to recall. The phonological form instead has to be retrieved via the non-lexical route, also called indirect route. Here, a reader makes informed, mental assumptions about the correct pronunciation of a word based on the language-dependent knowledge they have on the conversion of letter segments to sounds. That is, the phonological form is created by matching each orthographic segment of a word with an expected pronunciation. Words are therefore not parsed in their entirety (Coltheart 2005: 9).

They are, however, also not necessarily parsed letter-by-letter. This is because a letter-by-letter reading would in some cases - especially in English - lead to clumsy pronunciations. For instance, the pseudoword *phlonk would be pronounced as /phlonk/, i.e., /p/-/h/-/l/-/o/-/n//k/. In reality, English speakers most likely pronounce *phlonk as /floŋk/, the peculiarity being that the digraph <ph> is seen as one single orthographic segment to map the phoneme /f/ onto. Coltheart (1978) therefore argues that reading via the non-lexical route is not subserved by letter-by-letter parsing but rather by a grapheme-phoneme correspondence, wherein a grapheme is "any letter or letter sequence that represents a single phoneme" (Coltheart 2005: 9). This also helps "to diminish the amount of information that is processed, via data compression" (Grainger \& Ziegler 2011: 3). Having five phonemes, the pseudoword *phlonk consequently has five discrete graphemes: <ph>, <l>, <o>, <n>, and <k>. However, here, the grapheme-phoneme correspondence faces a problem: it does not account for the fact that more than just <ph> appears to be treated as one segment in *phlonk inasmuch as < $\mathrm{n}>$ is velarised to $/ \mathrm{y} /$ by preceding $/ \mathrm{k} /$. The letter sequence $<\mathrm{nk}>$ must therefore also be parsed as one segment - or it is at least not parsed in isolation. Accordingly, Martin \& Wu (2005: 392) note that "there is considerable evidence indicating that units larger than the single grapheme are involved" in reading along the non-lexical route.

### 3.1.1.3 Synergy of both routes

Both routes together constitute the DRC model (Rayner \& Reichle 2010: 788). On the one side, if only the lexical route existed, readers would neither be able to read unknown words nor pseudowords aloud. On the other side, if only the non-lexical route existed, even healthy (as in, non-impaired) readers would constantly make mistakes while assigning phonemes to letter segments. This is because languages are likely to have inconclusive, "irregular" orthography, leading to the expected pronunciation of a word to be incorrect. For instance, by
associating the rime -int with words like flint, mint, or sprint, where <i> equals $/ \mathrm{I} /$, the nonlexical route will incorrectly assign the same phoneme /i/ to the word pint (/aı/) (Coltheart et al. 1993: 589; Coltheart \& Rastle 1994: 1197; Luzzatti \& Whitaker 2006: 21). Readers therefore have to learn the correct pronunciation of an irregular word, add it to their mental dictionary, and then access it via the lexical route of reading. ${ }^{2}$

That is not to say, however, that simply knowing how a word should be pronounced will always lead to the correct pronunciation. Even if pint already has an entry in the mental dictionary, readers may still accidentally revert to assigning the incorrect phoneme / $\mathrm{I} /$ to it. This is by reason of both routes of the DRC model firing at the same time when reading a word, rather than there being a process that first detects whether the word is known and then only activates either the lexical route or the non-lexical route. ${ }^{3}$ Thereby, the DRC model is a cascading model, where simply identifying a word causes a compulsorily, subsequent activation of all sub-steps part of the DRC model. It is in contrast to threshold models, where one sub-step has to be fulfilled before the next can start (Coltheart et al. 2001: 212). Since both routes are activated simultaneously, irregular words are faced with competing information: the mental dictionary of the lexical route prefers to read pint with the diphthong /ai/, while the non-lexical route prefers the monophthong /I/. As a direct consequence, reading irregular words aloud is often affected by delays or output mistakes (Coltheart \& Rastle 1994: 1197; Coltheart 2005: 10). On the other hand, for regular words such as sprint, the simultaneous activation is not inhibitory, inasmuch as both routes come to the same conclusion of $\langle\mathrm{i}>$ having to be read as $/ \mathrm{I} /$. This allows for regular words to generally be pronounced faster.

Another factor that contributes to increased word-reading speeds is frequency: it is assumed that the more often a word's phonological form (of both regular and irregular orthography) is accessed via either route, the smoother its path becomes, thus accelerating future access (Coltheart 2005: 10; Luzzatti \& Whitaker 2006: 21; Rayner \& Reichle 2010: 789).

[^1]Figure 1 displays the entire DRC model as a box-and-arrow diagram. The arrows on the non-lexical side are one-sided, whereas the arrows on the lexical side are two-sided. This is necessary because any phonological form created via the non-lexical route has to be able to also activate the semantics of real words (that is, not pseudowords) in the mental dictionary, here called orthographic input lexicon. It does so by travelling back upstream the lexical route (Coltheart \& Rastle 1994: 1198; Grainger \& Ziegler 2011: 1). The product of both routes arrives at the phonological buffer, which is a "short-term store interfacing the phononogical [sic] representations with those devoted to the articulatory planning" (Luzzatti \& Whitaker 2006: 21), i.e., it is in charge of keeping all phonological information in the working memory for long enough to be articulated (Haluts et al. 2020: 1).


Figure 1: All steps of the dual-route cascaded model. The figure has been created by combining the structure and terminology of the diagrams drawn by Coltheart \& Rastle (1994: Figure 1), Luzzatti \& Whitaker (2006: Figure 4), as well as Pritchard et al. (2012: Figure 1).

To summarise, Table 1 below restates whether the lexical route or the non-lexical route is activated in the phonological retrieval of different types of words. For this table, it is assumed that the reader does not know the words reorganisation and tergiversate. ${ }^{4}$ However, it is possible for them to guess the basic semantics of reorganisation by noticing its morphemes re- 'again', organise 'arrange', and -sation as a nominaliser. Considering that the reader can therewith infer the meaning 'act of arranging something anew', it should be possible to access the semantics even of unknown words. In the case of known words with irregular pronunciation and unknown words with transparent morphemes, the lexical route is activated for semantic information, but not as main means of phonological retrieval (Coltheart \& Rastle 1994: 1198).

[^2]Table 1: Activation of either the lexical route or non-lexical route in phonological retrieval based on different word types

|  |  | Activation of: |  |
| :--- | :--- | :---: | :---: |
| Type of word | Example | Lexical <br> route | Non-lexical <br> route |
| Known word, regular pronunciation | sprint $(/ \mathrm{I} /)$ | x | x |
| Known word, irregular pronunciation | pint $(/ \mathrm{aI} /)$ | $(\mathrm{x})$ | x |
| Unknown word, <br> transparent morphemes | reorganisation $^{\mathrm{a}}$ | $(\mathrm{x})$ | x |
| Unknown word, <br> non-transparent morphemes | tergiversate $^{\mathrm{a}}$ | - | x |
| Pseudoword | *phlonk | - | x |

Notation: $\mathrm{x}=$ immediate activation, $-=$ no activation, $(\mathrm{x})=$ activation to access semantics (but not phonology) a. It is assumed that the speaker does not know the words reorganisation and tergiversate.

### 3.1.2 Parallel-distributed-processing model

The parallel-distributed-processing (PDP) model, also called connectionist or triangle model, was created by Seidenberg \& McClelland (1989) as a direct response to the dual-route cascaded (DRC) model proposed by Coltheart (1978) and other dual-route theorists (Plaut et al. 1996: 57). The PDP model and DRC model have mutually exclusive opinions on how phonological retrieval is achieved when reading words aloud (Rayner \& Reichle 2010: 788).

### 3.1.2.1 General structure

The PDP model proposes that cognitively, there are three rudimental groups of processing units necessary for reading words aloud: semantic units, orthographic units, and phonological units. All of these groups of units are bilaterally interconnected, meaning that they are equipped with both input and output mechanisms. For example, reading a word aloud will activate certain orthographic input units, certain semantic input units and, at some stage, phonological output units (Plaut et al. 1996: 56-59; Rayner \& Reichle 2010: 789). The processes necessary to achieve phonological output run in parallel (Seidenberg 2005: 241). However, neither input nor output are represented in concrete ways (Rayner \& Reichle 2010: 789). They are instead to be seen as "distributed patterns of activity" (Plaut et al. 1996: 58) across each unit group. Semantic, orthographic, and phonological information is thereby not represented as particular elements in any mental dictionary ready to be accessed via look-up procedures (as the dual-route theory would propose), but it is rather incorporated in the bilateral connections between each unit group (Rayner \& Reichle 2010: 789). One word will always have the same pattern of activity, and words similar in semantics, orthography, and/or phonology will have similarly distributed patterns of activity (Plaut et al. 1996: 58). For
instance, the word make being orthographically, phonologically, and to some extent semantically similar to the word bake should give them comparable patterns of activity.

The aspect of having distributed patterns running parallelly gives the model the name parallel-distributed-processing model. It is also called a connectionist model for its focus on the connections on which activity patterns propagate. Since these connections bilaterally interact with three groups of processing units, the PDP model can be represented as a triangle, hence allowing for the name triangle model (Seidenberg 2005: 239-241). Figure 2 displays Seidenberg \& McClelland's (1989) PDP model as adapted by Plaut et al. (1996: Figure 1). Each oval represents a group of processing units. The empty ovals represent additional hidden units, which "increase the computational capacity of the network" (Seidenberg 2005: 239). The arrows stand for the bilateral connections between each unit group.


Figure 2: A redrawing of Seidenberg \& McClelland's (1989) parallel-distributed-processing model as adapted by Plaut et al. (1996: Figure 1). The stylised IPA in the original (/mAk/) was exchanged for the actual IPA of <make>, /merk/. Each oval stands for processing units, while the arrows stand for the bilateral connections between each unit group. The empty ovals represent hidden units.

Before coming to the right (or wrong) pronunciation of any word, each unit gives collaborating and/or competing information, because all units interact across all connections at all times (Plaut et al. 1996: 56, 58). However, with each word read, the connections learn new word-internal information, such as the pronunciation of different letters and letter sequences. Thereby, assumptions about the correct pronunciation of words are constantly adjusted: the words make, gave, strange all teach the system to pronounce the single letter <a> as /eI/ in English, while the word have counterbalances this by <a> being pronounced as $/ æ /$. These competing pieces of information can then be statistically weighed against each other when reading a pseudoword like *mave, which should prefer the diphthong /eı/ (Plaut et al. 1996: 59-62). The more often a word is read, the stronger each connection becomes, thus
increasing reading speeds for frequent words (Rayner \& Reichle 2010: 789). Because of its experience-sensitive connections, the PDP model does not require two separate routes with separate mechanisms (mental dictionary on the one hand and grapheme-to-phoneme correspondences on the other) for parsing lexical information. It can read words and pseudowords with the same distributed patterns (Plaut et al. 1996: 56).

Plaut et al. (1996: 102) claim that this absence of two separate mechanisms within the same model gives the PDP model an "important advantage of simplicity over the dual-route approach". However, Plaut et al. (1996) are very much an exception in calling the PDP model simple. Opponents go as far as arguing against even considering it an option for theories on cognition based on how complex it is (Plaut et al 1996: 58; cf. Massaro 1988; McCloskey 1991; Forster 1994 for these arguments against the PDP model). Even the creator Seidenberg (2005: 238) acknowledges that "the main drawback of [this model] is that people find [it] difficult to understand. The technical aspects can be intimidating; the fact that [it] conflict[s] with intuitions about reading doesn't help". This intuition Seidenberg (2005: 238-239) talks about is precisely the dual-route model, i.e., the idea that words and pseudowords require separate mechanisms for processing.

### 3.1.2.2 Question of regularity

Regardless of how difficult the PDP model is to grasp, it still presents concrete criticisms against the DRC model. In particular, connectionist theorists question the way dual-route theorists categorically discriminate between regular and irregular words (Plaut et al. 1996: 6062, 102; Seidenberg 2005). To elaborate on this, it is necessary to first examine the view on regularity as presented in the DRC model:

> The terms exception [= irregular] and regular can only be defined with reference to some set of rules of correspondence between orthography and phonology. For any such set of rules, regular words are those for which the pronunciation generated by applying these rules is the correct pronunciation, and exception words are those for which application of the rules yields an incorrect pronunciation.
> (Coltheart \& Rastle 1994: 1197)

The single letter <i>, like mentioned in §3.1.1.3, as a rule has the pronunciation of $/ \mathrm{I}$, which is why flint, mint, and sprint are all regular words. Pint is then an irregular word since <i> read as /ai/ goes against the established rule in the DRC model (Coltheart \& Rastle 1994: 1197). While this view is not exactly incorrect, the PDP model argues that DRC theorists miss an important factor by only focusing on a single letter. Namely, they ignore that words are not
just jumbled up letter sequences where no grapheme ever corresponds to the "right", rulecomplying phonemes. The only irregular component in the word pint is the letter <i>. All other graphemes - that is, <p>, <n>, and <t>-are entirely regular in analogy with words such as pant or punt. Even <i> read as /at/ is not as irregular when considering that the word pine (/ar/) shares the same trait (Plaut et al. 1996: 102; Seidenberg 2005: 238). This makes the word pint quasi-regular or at most inconsistent, but not entirely irregular in the PDP model (Seidenberg 2005). Since all components of words can reference information from other known words to produce the correct pronunciation, Seidenberg (2005: 238) questions how DRC theorists "say, in effect, that what the beginning reader learns about pronouncing pant and pine has no impact on learning pint, or vice versa. This seems unlikely". Next to rejecting the necessity of having two separate routes with separate mechanisms for words and pseudowords respectively, this also gives the PDP model a reason to reject the dual-route concept when reading regular and irregular words: why would the irregular word pint need to access any mental dictionary for phonological retrieval rather than moving along the grapheme-to-phoneme path if three out of four letters are perfectly regular (Plaut et al. 1996: 102)?

According to the PDP model, the only acceptable reason for claiming that different "routes" operate in the reading of words is when referring to the bilateral connections between the semantic, orthographic, and phonological units of the PDP model as routes or pathways. For example, turning orthographic units into phonological units can be said to propagate along a phonological pathway, and turning orthographic units into semantic units can be said to propagate along a semantic pathway (Plaut et al. 1996: 100). It is therefore not specifically the notion of routes which the PDP model rejects, but the notion that one route works on lexical processing, while the other works on grapheme-to-phoneme processing (Plaut et al. 1996: 59). The only reason why the PDP model is not called triple-route model is because the term routes implies two different cognitive mechanisms in the DRC model (Coltheart et al. 1993: 590).

### 3.1.2.3 Accuracy of predictions on word pronunciation

The computational versions of each model show that both the DRC model and the PDP model are able to more or less correctly predict the pronunciation of all types of words, i.e., regular and known words, irregular (inconsistent) words, as well as pseudowords. However, the computational PDP model is considerably worse than the computational DRC model at guessing the correct pronunciation of pseudowords by standard of what pronunciation skilled readers would choose (Coltheart et al. 1993: 593; Plaut et al. 1996: 57). Specifically, the DRC
model scored with an accuracy of $98 \%$, while the PDP model had an accuracy of only $51 \%-65 \%$ in separate experiments (Coltheart et al. 1993: 593-594). This, in combination with the PDP model having a more complex framework, gives the DRC model an advantage as a cognitive theory for reading aloud words. To summarise, Table 2 below depicts similarities and differences between the DRC model and the PDP model.

Table 2: Similarities and dissimilarities of the dual-route cascaded model and the parallel-distributed-processing model

|  | Model |  |
| :--- | :---: | :---: |
| Has separate mechanisms for reading <br> words versus irregular words/pseudowords | DRC | PDP |
| Can read regular words | yes | no |
| Can read irregular (inconsistent) words | yes | yes |
| Can read pseudowords | yes | yes |

Notation: DRC = dual-route cascaded, $\mathrm{PDP}=$ parallel-distributed-processing

### 3.1.3 Brain regions involved in word-processing

Being a complex process (Rayner \& Reichle 2010: 787), reading words aloud activates a wide range of brain regions, but it is possible to name a few of the most crucial neuronal correlates involved. Two of these are the ventral stream and the dorsal stream. The ventral stream is also known as the what pathway in visual processing inasmuch as it is associated with parsing what entity is seen as a whole. In juxtaposition to this, the dorsal stream is known as the where pathway, which deals with the question of where each entity is in relation to each other. This is immediately applicable to the dual-route cascaded model: what, in this case, refers to the whole-word analysis associated with the lexical route, while where refers to the segment-by-segment analysis associated with the non-lexical route (Grainger \& Ziegler 2011: $9-10$ ). Since the neuronal correlates of word-processing seem to favour the dual-route cascaded model over the parallel-distributed-processing model, they will be described using the terminology of the DRC model in the following.

For the lexical route, the occipitotemporal lobes are key. The fusiform gyrus is activated when dealing with the visual component of reading known words. Through the ventral stream, it is connected to the middle temporal gyrus (MTG), which participates in semantic processing, and to the inferior frontal gyrus (IFG), which functions as the phonological buffer by preserving all information on the phonological components of a word before its articulation (Kearns et al. 2019: 179).

The key region for the non-lexical route lies in the temporoparietal lobes. Here, the supramarginal gyrus (SMG) allows for the mapping of graphemes to phonemes central to the non-lexical route. The SMG is connected to the angular gyrus (AG), which might subserve semantics, and to the phonological buffer of the IFG via the dorsal stream (Kearns et al. 2019: 179-180). Figure 3, adopted from Kearns et al. (2019: Figure 2), is a lateral depiction of the brain with the different regions thought to be involved in the process of reading.


Figure 3: Different brain regions involved in the reading process. The figure was created by Kearns et al. (2019: Figure 2). Slight adjustments were made.

It is to be noted, however, that not all readers employ the same cognitive mechanisms for reading words aloud (Grainger \& Ziegler 2011: 10; Kearns et al. 2019: 180). For example, children and other beginner readers as well as dyslexic adults are much more likely to additionally activate the left precentral gyrus ( $\operatorname{PrG}$ ), which is typically associated with speech production. It is assumed that this region is, in this case, used to subserve articulation by beginner and/or unskilled readers to make up for their inferior abilities in mapping graphemes to phonemes (Kearns et al. 2019: 180). This can be disregarded in the context of this work, since only healthy adults were questioned in the present study.

### 3.2 Models for number-processing

Much like reading words aloud, reading numbers aloud is a complex process as well (Dehaene 1992). It can be explained thoroughly with two models. The first (§3.2.1) is the triple-code model, which was championed by Dehaene (1992). It is considered "the most influential cognitive model of number processing to date" (Lindemann \& Fischer 2015: Chapter 3:4) and still finds recognition today (Dotan \& Friedmann 2018: 2). Rather than focussing on the aspect of reading numbers aloud only, it deals with the processing of numbers generally and is thereby more wide-ranging than reading models of word-processing. There are currently no noteworthy competing models (Dotan \& Friedmann 2018: 2), thus further contrasting the many models theorised for word recognition.

As a consequence, Dotan \& Friedmann's (2018) model for multi-digit reading, the second model presented (§3.2.2), does not contradict Dehaene's (1992) triple-code model. It instead offers a detailed step-by-step description for forming spoken words from printed digits in line with Dehaene's (1992) framework.

### 3.2.1 Triple-code model

According to Dehaene (1992), the cognitive representation and manipulation of numbers differs based on what numerical task is presented. That is, choosing which of two numbers is larger has a different basic cognitive representation than, for example, multi-digit arithmetic, and a different representation than counting from one to ten aloud. Dehaene (1992) discerns three such cognitive representations, labelled codes, in his triple-code model: the analogue magnitude code, the visual (Arabic) code, and the auditory verbal code.

### 3.2.1.1 Analogue magnitude code

The analogue magnitude code, also called analogue magnitude representation, is used to represent numerical quantity, i.e., the "nonverbal semantic [information about] the size and distance relations between numbers" (Dehaene et al. 2003: 488). Through this code, it is possible to recognise the magnitude of, for instance, the number 2 on its own, as well as to recognise the number 2 as being lower than the number 3 . However, the analogue magnitude code also processes the magnitude of non-symbolic information when judging item quantity, height, size, and similar measurements (Rousselle \& Noël 2007: 373; Cappelletti 2015: Chapter 44:1). Table 3 depicts how both symbolic input (the digits 2 and 3 ) and non-symbolic input (differently sized bars) are processed via the analogue magnitude code.

Table 3: Symbolic and non-symbolic processing achieved with the analogue magnitude code

| Example | Type |  |
| :---: | :---: | :---: |
|  | Symbolic | Non-symbolic |
|  | 23 |  |
| Processed | The magnitude of these numbers is two $(\cdot \bullet)$ and three $(\cdots)$. | The magnitude of these bars is two $(\cdot \bullet)$, i.e., there are two $(\cdot \bullet)$ bars. |
| information | Two $(\cdot \bullet)$ is a lower magnitude than three ( $(\cdot \bullet)$. | The magnitude of the left bar is smaller, i.e., the left bar is shorter than the right bar. |

Being non-verbal, the analogue magnitude code also allows for a quick estimation of the quantity of, say, apples on a table without the need to verbally count them. The lower the quantity of items presented, the more likely it is for the quantification to be faster. In fact, in a range of one to three (or four) items, reaction times are so fast that the process of cognising the correct quantity has its own term, namely subitising, rather than speaking of estimation (Dehaene 1992: 9-19; Núñez \& Marghetis 2015: Chapter 21:5). The mechanisms of subitising, non-verbal counting, and estimation exist in other species as well, making the analogue magnitude code the only cognitive numerical representation humans share with nonhuman animals (Dehaene 1992: 9-14). This also means that "the ability to process numerical magnitude can be independent of language" (Plodowski et al. 2003: 2046).

While it may be separate from language, the analogue magnitude code is inseparable from spatial awareness. There is overwhelming evidence for the cognitive representation of numerical quantity to be represented via a mental number line (e.g., Dehaene et al. 1993; Fischer 2001; Gevers et al. 2003; Nuerk et al. 2004; Shaki \& Petrusic 2005; Fischer \& Shaki 2014). That is, numbers are mentally aligned from a smaller to larger magnitude in a certain direction, such as left-to-right. This hypothesis is the result of so-called spatial-numerical association of response codes (SNARC) experiments, in which participants consistently distinguish smaller numbers "faster and more accurately with left-side button presses and large numbers [...] increasingly faster with right-side button presses" (Fischer \& Shaki 2014: 1462). Since small numbers are more accurate with the left-hand presses, they should consequently be associated with left space. However, the direction of the mental number line, and with it the resulting effect of the SNARC experiments, can also be reversed to right-toleft (Dehaene 1992: 22; Fischer \& Shaki 2014: 1464).

The direction of the mental number line appears to be influenced by the reading direction of a language：having been immersed in a left－to－right reading language，speakers of English most likely mentally represent smaller numbers further to the left than larger numbers．In languages reading right－to－left，smaller numbers are further to the right，and in languages reading up－to－down，smaller numbers are further up．Subsequently，bilinguals or monolinguals speaking languages with multiple reading directions and／or number systems adopt flexible mental number lines（Fischer \＆Shaki 2014：1464）．Note that this means that while the processing of magnitude alone might be independent of language，the spatial awareness concomitant with magnitude is less likely to be．Fittingly，Nuerk et al．（2015： Chapter 7：7）argue that the mental number line is not an inherent feature of the analogue magnitude code，but that it rather has its own cognitive representation which consistently co－activates when encountering magnitude．

Regardless of its representational status，the mental number line is not，however， subject to the reading direction of a language only．Its orientation is instead also influenced by ＂cultural immersion and spatially directional habits such as［．．．］finger counting＂（Fischer \＆ Shaki 2014：1467）．This allows for the mental number line to potentially adopt other conceptual metaphors like down is low，resulting in lower numbers being mentally represented further down（Winter \＆Matlock 2013；cf．Ito \＆Hatta 2004 for an account of how Japanese speakers＇reading direction and SNARC effect appear to dissociate）．

## 3．2．1．2 Visual（Arabic）code

The visual Arabic code，also called visual Arabic number form，is activated when reading or writing single or multi－digit numbers，such as 12 （Dahaene 1992：31）．Despite its original name referring to Arabic digits only，the code is also activated for any other standard symbolic representation of numbers．The number 12 therefore equally triggers the visual Arabic code for English speakers as much as 十二＇12＇triggers it for Chinese or Japanese speakers（Nuerk et al．2015：Chapter 7：7）．${ }^{5}$ For this reason，the visual Arabic code will henceforth be referred to as visual code only，unless examples specifically include Arabic digits．

The visual code allows access to parity judgments，i．e．，the recognition of a number being even or odd（Dahaene 1992：33）．It is also used to subserve most forms of arithmetic operations since these＂seem to involve the mental manipulation of a spatial image of the

[^3]operation in Arabic notation" (Dahaene 1992: 33). Whether arithmetic operations are represented through the visual code or instead the auditory verbal code discussed below is assumed to depend on the frequency and difficulty of the operation in question. Specifically, high-frequency, low-difficulty single-digit addition and multiplication do not need to be manipulated with the visual code because they were most likely learnt by heart. This allows them to be retrieved from long-term memory via language modules rather than having to be computed. Thus, the visual code only mainly supports arithmetic operations for actual calculating processes (Dehaene 1992: 33; Willmes 2018: 81).

### 3.2.1.3 Auditory verbal code

Whenever operating with numerals rather than digits, the auditory verbal code, or auditory verbal word frame, is used. The term numerals incorporates both a written number word, such as <twelve>, as well as its spoken counterpart, /twelv/ (Dehaene 1992: 30). The auditory verbal code is the standard representational form of "list counting (forwards and backwards), reading out/naming numbers, and writings numbers to dictation" (Willmes 2018: 77). Only in this code does language therefore play a direct role (Dehaene 1992: 30).

As noted above, arithmetic operations may find themselves represented with the auditory verbal code when they are stored in the long-term memory through rote memorisation. This is mostly the case for single-digit addition and multiplication tables. An operation like $3 * 3=9$ is thus not retrieved by loading the working memory with a manual calculation, but rather by means of reciting the verbal information three times three is nine (Dehaene 1992: 33; Willmes 2018: 81). The fact that language-based memorisation plays a role in arithmetic also explains why bilinguals prefer to calculate in their language of learning for mathematics, even if it dissociates from their mother tongue (Dehaene 1992: 29). However, Barrouillet (2018: 362) notes that retrieval from long-term memory is not "necessarily the fastest cognitive process that humans have at their disposal when dealing with numbers". For an operation such as $3 * 3=9$, he therefore suggests that it is not the verbal solution nine that is directly retrieved, but instead the memorised algorithmic process itself, i.e., information on how to calculate the operation the fastest (Barrouillet 2018: 371381).

### 3.2.1.4 Transcoding

It is possible - and for most tasks necessary - to switch between different codes of the triplecode model. Dehaene (1992) calls this transcoding. On the most basic level, all three codes are interconnected inasmuch as it is possible to bilaterally transcode between the analogue magnitude code and the visual code, between the visual code and the auditory verbal code, as well as between the auditory verbal code and the analogue magnitude code without having to pass through the respective third code as a sub-step (Dehaene 1992: 31-32). Figure 4, adapted and simplified from Dehaene (1992: Figure 5), illustrates each code of the triple-code model within an octagon, whereas arrows to and from each octagon indicate the bilateral transcoding paths.


Figure 4: The triple-code model, adapted and simplified from Dehaene (1992: Figure 5). The octagons represent one of the three codes. The arrows to and from each octagon represent transcoding paths between each code. There is an example with the number 12 in all codes: the Arabic multi-digit number 12 for the visual code, the number 12 on an imaginary number line for the analogue magnitude code, and the spoken form /twelv/ as well as the written form <twelve> for the auditory verbal code.

An example for a task that requires transcoding is reading Arabic digits aloud. First, the written number 12 is represented with the visual Arabic code. It then has to be transcoded into the auditory verbal word frame /twelv/ before being sent to the articulatory system to form an active utterance (Dehaene 1992: 31-32). This is an intricate undertaking (Dehaene 1992: 31), which requires a high capacity of working memory "in charge of the maintenance and transformation of the chain of digits under construction" (Barrouillet 2018: 368). Transcoding Arabic digits into numerals is more closely looked at in §3.2.2.

As noted above, in order to articulate the word /twelv/ after transcoding 12, the triplecode model technically indicates that an intermediate activation of the analogue magnitude code, that is, grasping the quantity of twelve, is not necessary. This does not mean, however,
that it is not activated at all．Instead，the analogue magnitude code appears to occupy a special position within the triple－code model，in which it is activated near－automatically regardless of the task executed and regardless of whether transcoding is involved in the task（Nuerk et al． 2015：Chapter 7：7；Willmes 2018：85；but cf．Brysbaert 2018：11－13 for a different account）． Just parsing 12 therefore activates the analogue magnitude code as much as reading out loud 12 as／twelv／，or vice versa，writing down the spoken word／twelv／as 12 ．This also stays true when adding the variable of a foreign language，although it might be expected that a foreign language learner of，say，Japanese could read the number word 〈じゅうに〉 juu－ni＇twelve＇ without having to comprehend any quantity at all（Duyck \＆Brysbaert 2004；Ganayim \＆ Ibrahim 2014）．${ }^{6}$

It can consequently be expected that transcoding to（but not from）the analogue magnitude code requires much less cognitive effort than transcoding between the auditory verbal code and the visual code．Considering that even non－human animals possess the analogue magnitude code（Dehaene 1992：9－14），it occupying a near－automated，core position is not surprising．The analogue magnitude code is，however，likely not the only code to experience more automated transcoding．Rather，it was found that the cognitive effort of transcoding from the auditory verbal code to the visual code（one－way）might also decrease when less working memory is required for the process．This is assumed for frequently transcoded numbers，such as／tu：／to 2 （Barrouillet 2018：364－369）．

## 3．2．2 Model for multi－digit reading

Within his triple－code model，Dehaene（1992：31）considers reading aloud numbers，i．e．，the act of transcoding Arabic digits into a word chain，＂a complex process［involving］separate steps of syntactic composition and lexical retrieval＂．This process is further looked at by Dotan \＆Friedmann（2018），who theorise on the involvement of two key mechanisms specifically when reading multi－digits numbers aloud．These mechanisms are visual analysis and verbal production．In line with Dehaene＇s（1992：31）statement，both of these have their own lexical and syntactic sub－mechanisms respectively（Dotan \＆Friedmann 2018：26）．The model for multi－digit reading is closely related to the reading model proposed by McCloskey et al．（1986）．

[^4]
### 3.2.2.1 Visual analysis

The first stage of Dotan \& Friedmann's (2018) model for multi-digit reading consists of parsing the digit identity, i.e., the question of what digits are even present within any given number. For a multi-digit number such as 2732 , this translates into the digits 2 , 3 , and 7 . In the second stage, a digit order encoder computes the relative order of each digit. That is, 2 is understood to be next to 7 , which is next to 3 , which is next to 2 . Although it might seem as if knowing the relative order of 2-7-3-2 is enough to correctly formulate the multi-digit number 2732, it is in fact not. This is because the brain has not yet parsed any information on how often each digit is present within the number read. In this stage of the visual analysis process, the numbers 2732 and 27327 therefore still appear to be the same number since the criterion 2 is next to 7 is true in both cases. Digit identity and digit order only form the lexical base of the number in question, meaning that a syntactic analysis is still required (Dotan \& Friedmann 2018: 3, 20-21).

On a syntactic level then, the decimal structure of multi-digit numbers is deciphered in the third stage. This decimal structure comprises three parts: length encoding, triplet parsing, and zero encoding. Length encoding provides absolute information on the quantity of digits present, which then allows the number to be subdivided into triplets. The four digits of the number 2732 are thereby separated into 2 and the triplet 732 (Dotan \& Friedmann 2018: 3, 21). In this model, even speakers of languages using a myriad number system, such as Japanese, would first visually parse multi-digit numbers into triplets and then, if necessary, restructure them into myriads for verbal production (Dotan \& Friedmann 2018: 23-24; more on which in §5.3). ${ }^{7}$

Dotan \& Friedmann (2018: 21) found that the digit 0 appears to occupy a special role inasmuch as it is the only digit not computed by the digit order encoder in the lexical stage of number processing. Instead, only now, its existence and its position are parsed in what they call zero encoding. This "may help the digit [order] encoders skip 0's and avoid sending them as digit identities to the production stage" (Dotan \& Friedmann 2018: 21) because they do not actually need to be read aloud. Using all information acquired through the lexical and syntactic visual analyses, a number word can be created for verbal production.

[^5]
### 3.2.2.2 Verbal production

Before actual verbal production can take place, the visual information of the number in question has to be restructured into a format adequate for articulation. That is, not only do digits have to turn into numerals, but language-specific rules, such as the inversion of tens and units (e.g., German fünfundvierzig 'forty-five', lit. 'five and forty'), must be applied as well.

There are many sub-processes necessary in order to achieve this. The first step is for the decimal structure of a number, which was parsed in the visual analysis process, to be turned into a number tree. This means that a number's length and triplet structure are used to hierarchically unravel said number into its thousands, hundreds, tens via nodal representation. Dotan \& Friedmann (2018: 23) specifically see this as "analogous in a way to the syntactic trees that represent the syntactic structure of sentences". For better understanding, Figure 5 displays how the number 2,372 can be represented in a number tree.


Figure 5: Hierarchical ordering of the number 2,372 in a number tree

However, because they only make up the very framework of numerals, number trees in Dotan \& Friedmann's (2018) model are de facto still entirely independent of specific digits present within any number. Therefore, almost every, say, three-digit number has the same tree as other three-digit numbers, and every two-digit number has the same as other two-digit numbers, etc. ${ }^{8}$ In fact, this stays true across multiple languages, as long as they utilise the same number grouping system: English and German, both using the triplet number system, have the same number trees, while Japanese, using the myriad number system, has different number trees (Dotan \& Friedmann 2018: 23-24). Figure 6 (I) displays a digit-independent number tree for any five-digit number in a language utilising the triplet number system. To contrast, Figure 7 (I) below displays a digit-independent number tree for any five-digit number in a language utilising the myriad number system.

[^6]

Figure 6: Visualisation of a digit-independent number tree and its linearised version for any five-digit number in a triplet number system. (I) displays the number tree. The \#-symbol visualises how number trees in Dotan \& Friedmann's (2018) model for multi-digit reading are digit-independent. It can represent any digit from 1-9. The digit 0 can also fill each \# as long as it is not the first component of the number, because, for example, a number like 02372 is in reality just 2372 and therefore not a five-digit number. (II) shows the linearised version of the number tree. The figure is a recreation of the number tree and its linearised version created by Dotan \& Friedmann (2018: Figure 3).


Figure 7: Visualisation of a digit-independent number tree and its linearised version for any five-digit number in a myriad number system. (I) displays the number tree. The \#-symbol can represent any digit from $0-9$, as long as the digit 0 is not the first component of the number. (II) shows the linearised version of the number tree. This figure follows the representation of a number tree and its linearised version by Dotan \& Friedmann (2018: Figure 3).

Unlike the visual analysis process, where multi-digit numbers were parsed into triplets regardless of the number system of a language, the number in question now has the correct language-dependent number structure to add words to. So, in the second step of verbal production, the top-down hierarchical representation of the number tree is turned into a single string formation of verbal components necessary to pronounce the number. Dotan \& Friedmann (2018) call this process linearisation. Both Figure 6 and Figure 7 show this in (II). Considering that the string formation is directly derived from the digit-independent number tree, it itself is also still entirely independent of what digits are present in the number. This means that all five-digit numbers in English have a structure of \{_:tens\} \{_:units\} [thousand] \{_:units\} [hundred] [and] \{_:tens\} \{_:units \}. ${ }^{9}$ Note that the language now has to be specified as being English (rather than talking about triplet number systems generally) because the addition of and is not a universal component of numerals. The notation works as follows: function words like and find themselves in square brackets [ ... ], but are not supposed to represent speech sounds. Since multiplier words such as thousand are lexicalised words, they are also represented in [ ...]. ${ }^{10}$ Curly brackets $\{\ldots\}$ serve as a placeholder for different lexical classes of numerals. That is, $\left\{\_\right.$:units $\}$represents an unspecified digit between $0-9$, while \{_:tens\} represents one of the unspecified numbers $10,20,30, \ldots$, or 90 . The differentiation is made because in English, units have different numeral formation rules than tens: specifically, tens at least need the additional morpheme -ty (e.g., sixty) and, in some cases, also a modified base for derivation (e.g., twen-ty instead of two-ty) (Dotan \& Friedmann 2018: 21-24).

However, the digit-independent string formation is not sufficient to create a numeral. This is because language-internal formation of numerals can widely differ based on what digits are actually present. For example, the notation \{_:tens\} \{_:units\} might be adequate for a numeral like forty-five, with forty belonging to the tens and five to the units, but it is not adequate for fifteen, where not only -teen forms its own lexical class, but where the tens and units are also inversed. The notation is also not adequate for twelve, inasmuch as it is a unique morpheme with zero transparency. Therefore, in order to get closer to the end result of a spoken numeral, the digit-independent string formation is then turned into what Dotan \& Friedmann (2018) call a number word frame in the third step. Here, the string formation is particularised to comply to the language-dependent and digit-dependent rules of numeral formation for the very specific number in question. The number word frame for the number 15,729, for example, is \{_:teens\} [thousand] \{_:units\} [hundred] [and] \{_:tens\} \{_:units\}.

[^7]The frame is identical to the digit-independent string formation, except that the initial notation of \{_:tens\} \{_:units\} was exchanged for the more specific class of \{_:teens\} (Dotan \& Friedmann 2018: 23-25).

With the number word frame created, its placeholders can be supplied with the digits of the number in question via the fourth step, digit-binding. The number 15,729 then has the filled number word frame $\{5:$ teens $\}$ [thousand] \{7:units $\}$ [hundred] [and] \{2:tens $\}$ \{9:units $\}$. The last step is for the complete number word frame to receive its phonological form and to be sent to articulation (Dotan \& Friedmann 2018: 25). However, the phonological retrieval of numerals is different to that of content words: whereas content words are retrieved from the phonological output lexicon, all components of a numeral (i.e., the words for each digit, multiplier words, as well as the function word and) are only retrieved during the phonological buffer step. This means two things for the phonological form of numerals: firstly, it is stored differently from that of content words, and secondly, it is retrieved later than that of content words (Dotan \& Friedmann 2018: 25; also see Figure 1 in §3.1.1.3 for a diagram of the phonological retrieval of content words). Figure 8, a redrawing of Dotan \& Friedmann's (2018: Figure 1) diagram, displays the entire process of multi-digit reading from visual analysis to verbal production.


Figure 8: Dotan \& Friedmann's (2018: Figure 1) model for multi-digit reading with slight adaptions. The term decimal word in the original was exchanged for multiplier word. A more detailed model for multi-digit reading can be found in Dotan \& Friedmann (2018: Figure 2).

### 3.2.3 Brain regions involved in number-processing

Even though there is insufficient data for a precise allocation of specific brain regions to all the tasks associated with numerical cognition, it is possible to identify a few wide-ranging, key regions. All of the following regions were researched with regard to the triple-code model, which is why terminology thereof will be used throughout. However, since Dotan \& Friedmann's (2018) model for multi-digit reading gives a precise account of digit-to-numeral transcoding in line with the triple-code model, the discussed brain regions should also be applicable to it.

The most important regions appear to be the parietal lobes (Cappelletti 2015: Chapter 44:2). For numerical quantity represented via the analogue magnitude code, specifically, "the intraparietal sulcus (IPS), which runs between the inferior and superior parietal lobes", (Holloway \& Ansari 2015: Chapter 29:8) is consistently found to be active. ${ }^{11}$ Nuerk et al. (2015: Chapter 7:7) specify the IPS to be stimulated bilaterally. The intensity with which the IPS reacts to numerical tasks is directly connected to how accurate the response has to be. For example, in a number comparison task, the IPS has to "work harder" in order to correctly identify which of two numbers is larger/smaller when the magnitude of the two numbers is close together. Therefore, a comparison of, say, 2 and 3 elicits a stronger activation of the IPS than a comparison of 12 and 45 (Holloway \& Ansari 2015: Chapter 29:9).

The IPS is hypothesised to not just activate for numerical magnitude. Instead, it may also find use in handling some tasks associated with the visual code as well as the auditory verbal code. Specifically, the IPS bilaterally might subserve the visual parsing of digits (visual code), while the left IPS might further subserve the parsing of written and verbal forms of a numeral (auditory verbal code) (Holloway \& Ansari 2015: Chapter 29:9). This would make the IPS a key region for all three codes of the triple-code model.

However, the neuronal correlates of the triple-code model reach farther than just the IPS, or the parietal lobes generally. For example, the visual recognition of digits associated with the visual code activates the occipitotemporal cortex (Plodowski et al. 2003: 2046; Cappelletti 2015: Chapter 44:2) as well as the right caudal fusiform gyrus. In fact, the latter region is said to react solely to digits (Plodowski et al. 2003: 2046; Skagenholdt et al. 2018: 4).

[^8]For print and speech, i.e., the auditory verbal code, language-relevant regions in the left hemisphere are activated. This comprises regions both inside and outside the parietal lobes, such as "the inferior frontal gyrus (IFG), and [...] the perisylvian language network: including the supramarginal gyrus (SMG), middle temporal gyrus (MTG), and superior temporal gyrus (STG)" (Skagenholdt et al. 2018: 4). Further, the left angular gyrus (AG) is necessary for "general verbal processing and verbal memory; especially [...] rote multiplication" (Skagenholdt et al. 2018: 4).

## 4. Hypotheses on linguistic-numerical reading

Considering that word-reading and number-reading have different cognitive models, switching between the reading of words and numbers should not remain unaffected. The main hypothesis (1) of this work is that there is switch cost when reading aloud an Arabic multidigit stimulus after reading aloud a word stimulus or when reading aloud a word stimulus after an Arabic multi-digit stimulus in comparison to a lack of switch cost when reading aloud word after word stimuli or digit after digit stimuli.

There are also multiple sub-hypotheses. It is anticipated that there is a shorter switch cost when reading a number followed by a word than when reading a word followed by a number (hypothesis (2). This stems from three assumptions about word-reading: firstly, it is expected that there are less reading delays between two words in comparison to two numbers because words are read more frequently than numbers (2)a). This effect should secondly be strengthened when considering that words can be read both by semantic word recognition and letter-by-letter reading, whereas Arabic digits can only be read by number recognition without a letter-by-letter representation (2)b). Thirdly, word-reading is further anticipated to generally be faster because the use of erroneous letters within words is less likely to affect the semantics and therewith the understanding of a word, while an incorrectly chosen digit irreversibly changes the semantics of a number (2)c).

Multiple factors are additionally expected to influence reading delays regardless of there being a switch or no switch within any sequence: namely, delays should be greater the longer the syllables of a (number) word (hypothesis (3), and the lower the language proficiency of a reader (hypothesis (4)). Although this is not analysed within this work, delays should also be greater the more complex the script and the number system of a given language are - both in comparison to the native tongue of the reader. Hypotheses (1) to (4) were tested by means of an experimental study described in the following.

## 5. Methodology

The present study was created in order to test whether foreign language learners of Japanese with different proficiency levels experienced significantly longer delays when reading aloud an Arabic multi-digit number stimulus after reading aloud a word stimulus or when reading aloud a word stimulus after an Arabic multi-digit number stimulus in comparison to reading aloud word after word stimuli or number after number stimuli in Japanese. The study itself consisted of two phases: phase one for reading word and number stimuli aloud, and phase two for translating Japanese vocabulary.

### 5.1 Participants

The present study was conducted with $n=18$ ( 9 female, 9 male) adult learners of Japanese at the University of Regensburg. All participants have a Japanese proficiency level of at least A2, with $n=8$ participants having successfully completed the University's introductory Japanese B1 course, $n=5$ participants having completed the introductory B2 course, and further $n=5$ participants having completed the advanced B2 course at the time of the study. The higher level of proficiency was actively chosen to ensure the participants would understand most (or ideally all) words prompted and that they would have at least some experience with Japanese numerals. In the following, the participants' language competency will be referred to using the levels $0-1-2$, where 0 stands for introductory B1 proficiency, 1 for introductory B2 proficiency, and 2 for advanced B2 proficiency. Table 4 displays the distribution of sex by Japanese proficiency of all participants. Before the study, each participant signed a written form of consent about the study's procedure and data protection.

Table 4: Distribution of sex by language proficiency of the participants of the present study

|  | Highest-level Japanese course successfully completed: |  |  |
| :--- | :---: | :---: | :---: |
|  | introductory B1 <br> (0) | introductory B2 <br> (1) | advanced B2 <br> (2) |
| male | 1 | 4 | 4 |
| female | 7 | 1 | 1 |

## 5．2 Language of choice：Japanese

## 5．2．1 Japanese script（s）

The study was conducted with foreign language learners rather than native speakers．Based on the assumption that less proficient speakers have longer delays for processing，this choice was made to ensure that any switch cost was properly measurable within the scope of this work． That is，delays needed to be in seconds rather than milliseconds．

The language used for the study was Japanese．The reasons for this lie both in its script（s）and in its number system．Japanese utilises a total of three scripts：the logographic characters Kanji adapted from Chinese，as well as the two moraic scripts Hiragana and Katakana（both together known as Kana）．Kanji characters are generally used for nouns．They also make up the semantic basis of verbs and adjectives（Dylman \＆Kikutani 2018：504）． Katakana mainly find use in the writing of modern loanwords；the word modern here excluding historical borrowings from Chinese，which are written in Kanji instead（Kess \＆ Miyamoto 1999：14）．Hiragana are typically used for adverbs and grammatical components of sentences，such as auxiliary verbs，verbal conjugations，or particles．Although it is technically possible to write any Japanese sentence with only Hiragana or only Katakana，authentic sentences usually consist of a sequence of Kanji，Hiragana，and sometimes also Katakana （Kess \＆Miyamoto 1999：14，30－31；Okamoto 2005：3；Dylman \＆Kikutani 2018：504）．

In the present study，however，only words written in Kana，specifically in Hiragana， were prompted．This has to do with the fact that Kana scripts are highly regular in their character－to－sound correspondences．In its simplest form，a Japanese syllable consists of a single mora，which consists of a simple（consonant and）vowel sound and corresponds to a single grapheme（Kess \＆Miyamoto 1999：83；cf．Tamaoka \＆Terao 2004；Kubozono 2017 for additional information on Japanese morae）．For example，in the word たまご tamago ＇egg＇，there is a one－to－one correspondence between the syllables，morae，and graphemes． Namely，there are three each：くた＞／ta／，〈ま＞／ma／，and くご〉／go／．The quantity of syllables sometimes differs from the quantity of morae and graphemes．This is the case for the word おおい ooi＇many＇，which has two syllables（／o：／and／i／），but three morae（／o／，／o／，and／i／）and three graphemes（〈お〉，〈お〉，and 〈い〉）．Still，the vast one－to－one correspondence between morae and graphemes and their simple structure remains．These aspects combined with the fact that the pronunciation of morae is only rarely irregular（Kess \＆Miyamoto 1999：83）all allow Japanese words written in Kana to be＂simpler＂to read than，for instance，the oft irregular grapheme－to－phoneme correspondences associated with English words（Tamaoka 2014：442－443）．To name an extreme example，the English word colonel／＇k3：nəl／has two
syllables，（no processing on the level of morae），seven graphemes，and highly unpredictable pronunciation（Coltheart et al．1993：589）．Tamaoka（2014：443）notes that this makes it much ＂more difficult to apply a phonological strategy to access a word＇s sound＂in English．

Thereby，Japanese has an advantage over，in this case，English as a foreign language in a reading task－at least when not accounting for the fact that all participants of the present study have much more experience with English as a foreign language than with Japanese． Choosing Hiragana characters ensured that participants were able to correctly read every word prompted within the study not just by semantic parsing but also by character－by－character parsing if a word was unknown to them（see §3．1）．The logographic Kanji mainly allow for a semantic decomposition（Kess \＆Miyamoto 1999：200－204），which is why they were not used in the study．Despite working the same way as Hiragana，Katakana characters were also excluded，since their usage is much less frequent than that of Hiragana（Kess \＆Miyamoto 1999：98）．The visual decoding of Katakana is also reported to be more difficult for foreign language learners of Japanese（Kess \＆Miyamoto 1999：89）．

## 5．2．2 Japanese number system

In spite of what is said above，Hiragana characters visually differ from the Latin script the German study participants are accustomed to．The reading of Hiragana is therefore not expected to go as smoothly as the reading of words in Latin script would．However，Japanese has another advantage in regard to this study＇s linguistic－numerical switch cost analysis：it has a simpler number system than German．It is an entirely regular，highly transparent base－10 multiplicative－additive number system．The only components necessary to form complete numerals are the number words for 1－9 combined with multiplier words such as じゅう juи ＇ten＇，ひゃく hyaku＇hundred＇，etc．${ }^{12}$ For example，the numeral for 56 in Japanese is literally ＇five ten six＇and the numeral for 18 is＇ten eight＇（Dehaene 1992：4）．Table 5 shows what Japanese numerals correspond to the numbers 12，14，and 47，respectively．To compare with another base－ 10 number system，Table 6 below depicts the German numerals that correspond to the same numbers 12，14，and 47．In both Table 5 and Table 6，an explanation of each numeral＇s structure is provided to the right．It can be seen that，on the one hand，Japanese numerals are exclusively composed of number words and multiplier words while utilising word order to designate meaning．This word order is equal to the positional notation of Arabic multi－digit numbers，meaning that tens precede units．

[^9]Table 5：Structure of select Japanese number words

| Number word | Structure |
| :---: | :---: |
| じゅうに <br> a． juu－ni ten－two ＇twelve＇ | Addition of ten and two is implied through the word order ten（＋）two． |
| じゅうよん <br> b． juи－yon ten－four ＇fourteen＇ | Addition of ten and four is implied through the word order ten（ + four． |
| よんじゅうなな <br> c． yon－juu－nana four－ten－seven ＇forty－seven＇ | Multiplication of four and ten is implied through the word order four ${ }^{(*)}$ ten．This equals to forty．Addition of forty and seven is implied through the word order forty $(+)$ seven． |

German numerals，on the other hand，in some cases make use of entirely non－transparent unique morphemes，like zwölf＇twelve＇in Table 6a，or they inverse the tens and units of two－ digit numbers，like vierzehn＇fourteen＇in Table 6b．German numerals can also consist of additional components，such as the grammatical morpheme und＇and＇as well as the marker $-z i g$＇－ty＇，like siebenundviezig＇forty－seven＇in Table 6c．This marker－zig＇－ty＇is used the same way as Japanese uses the multiplier word じゅう juи＇ten＇inasmuch as it denotes multiplication by ten（Dehaene 1992：4）．

Table 6：Structure of select German number words
Number word Structure
zwölf
＇twelve＇$\quad$ The numeral is a unique morpheme and thereby non－transparent． vierzehn $\quad$ In comparison to positional rules of Arabic notation，in which tens
vier－zehn
b．vier－zehn
four－ten
＇fourteen＇ are before units，the tens and units in the numeral vierzehn ＇fourteen＇are inversed．

## siebenundvierzig

sieben－und－vier－zig
c．
seven－and－four－ty
Like above，tens and units are inversed．The numeral further uses ＇forty－seven＇

Thus，it can be said that Japanese has a more transparent number system than German despite both languages utilising base－10．In fact，Dehaene（1992：4）notes that Japanese has one of the＂simplest base－10 multiplicative－additive notation［s］＂．For this reason，it is the language of choice for the present study．If a switch cost is found to exist between the reading
of a word and a number（and vice versa），it can then be traced back to there being different cognitive processes for reading words on the one hand and numbers on the other rather than delays emerging through＂difficult＂number systems alone．Further，although this is not tested within this work，if even higher－level foreign language learners show significant delays when reading aloud numbers with more transparent numerals than the numbers in their native language，it can be expected that the delays would increase when the foreign language number system is less transparent，or when it uses a different base for its number system．For example，if German speakers hesitate when turning the Arabic multi－digit number 97 into the Japanese numeral きゅうじゅうなな kyuu－juu－nana＇ninety－seven’（lit．＇nine ten seven＇），they will probably hesitate for a longer time when turning the same number into the French numeral quatre－vingt－dix－sept＇ninety－seven＇（lit．＇four twenty ten seven＇）as it employs less transparent digit－to－numeral correspondences．

## 5．3 Number length of choice：two－digit numbers

Numbers can be infinitely long，but only two－digit numbers were prompted within the study． This was decided upon by process of elimination．Firstly，the utilised numbers could not have various digit lengths in order to ensure that each number was comparable to the next． Secondly，single－digit numbers could not be used，since a mere ten numbers（from 0 to 9 ） would not allow for a large enough stimuli size．Thirdly，three－digit numbers（and higher） were not used，because the divergence in syllable lengths of their corresponding numerals is too great．While numerals of single－digit numbers have one to two syllables，two－digit numbers have one to five，and three－digit numbers have three to nine．For example，the numeral for 23 is にじゅうさん ni－juu－san＇twenty－three＇（three syllables），while the numeral for 786 is ななひゃくはちじゅうろく nana－hyaku－hachi－juu－roku＇seven hundred eighty－six＇ （nine syllables）．It is expected that the more syllables numerals have，the longer speakers automatically take to process said numerals before successfully reading them aloud．This makes it difficult to compare the onset delay between，in this case，any stimulus and three－ syllable numerals with any stimulus and nine－syllable numerals．

Fourthly，three－digit numbers（and higher）were further not used because there are little to no Japanese words of the same syllable length．In order to properly compare any delay between utterances of words and numbers，the syllable length of each word within the study was deliberately chosen to echo the syllable length of the numerals prompted alongside it （more on which in §5．4）．It is difficult to find matching words for numerals with more than five syllables－especially those that intermediate foreign language learners would understand．

Fifthly，once numbers equal to or above the range of ten－thousand（i．e．，five－digits）are introduced，the assumed simplicity of the Japanese numeral system is lost for German learners of Japanese．This is due to the fact that Japanese uses a myriad system，in which ten－thousand has its own multiplier word，namely まん man ‘ten－thousand’（Dotan \＆Friedmann 2018：24）． Table 7 depicts that this multiplier word is then used as the base for even higher numbers， such as じゅらまん juu－man＇hundred－thousand＇，which literally translates to＇ten ten－ thousand＇．Considering that the myriad system is not the standard in English or German， where it is instead a triplet system with thousand as the preferred base（Dotan \＆Friedmann 2018：23－24），delays in the utterance of numerals would most likely stem from a confusion about the differences in numeral systems rather than just different cognitive processes taking place．

Table 7：Different methods of number grouping in English and Japanese

| Number | Numerals in <br>  <br> a triplet system | Japanese， <br> a myriad system |
| :--- | :--- | :--- |
|  | thousand | せん <br> sen <br> ＇thousand＇ |
| 10,000 | ten－thousand | まん <br> man <br> ten．thousand <br> ＇ten－thousand＇ |
| 100,000 | hundred－thousand | じゅうまん <br> juu－man <br> ten－ten．thousand <br> ＇hundred－thousand＇， |
| $1,000,000$ | （one）million | ひゃくまん <br> hyaku－man <br> hundred－ten．thousand |
|  |  | ＇（one）million＇ |

For the reasons mentioned above，it makes the most sense to prompt two－digit numbers．Further，although this is not tested in this work，it is expected that if higher－level learners show statistically significant delays even for low－digit numbers，the delays will likely increase for higher－digit numbers．

## 5．4 Material

For phase one of the study，participants had to read aloud a total of 72 Arabic multi－digit numbers in Japanese as well as 72 real（that is，not made up）Japanese words written in the Hiragana script．No number or word was ever repeated across the study．All stimuli were grouped into quadruplets，called stimuli string in the following，and then assigned to one of four different stimuli types based on their content．If the stimuli string consisted of a row of four words，it belonged to the word－word－word－word（WWWW）type．An example with added glosses can be seen in（3a）．In analogy，if the stimuli string consisted of a row of four numbers，it belonged to the number－number－number－number（NNNN）type，（3b）．To test for switch cost，there was a number－number－number－word（NNNW）type，（3c），and a word－word－ word－number（WWWN）type，（3d）．
（3）a．Stimuli string of the WWWW stimuli type

| しょくどう | せいかつ | れきし | たんじょうび |
| :--- | :--- | :--- | :--- |
| shokudou | seikatsu | rekishi | tanjoubi |
| ＇dining hall＇ | ＇life＇ | ＇history＇ | ＇birthday＇ |

b．Stimuli string of the NNNN stimuli type 36

74
82
c．Stimuli string of the NNNW stimuli type
45
60
93

こころ
kokoro
＇heart＇
d．Stimuli string of the WWWN stimuli type

| おんがく | てがみ | ゆらがた | 16 |
| :--- | :--- | :--- | :--- |
| ongaku | tegami | yuugata <br> ＇music＇ | ＇letter（mail）＇ |

Each of the stimuli types consisted of a total of nine different stimuli strings．Four of these strings had words and／or numbers whose numerals have three syllables，another four strings were for the length of four syllables，and one string was for five syllables．That is，all （number）words in a single string had the same syllable length to ensure comparability．The reason why this work does not exclusively deal with，for example，three－syllable stimuli only is based on the fact that the numerals of Japanese two－digit numbers are not equal in syllable length．Instead，they have one syllable（e．g．，じゅう juи＇ten’）to five syllables（e．g．，なな じゅうなな nana－juu－nana＇seventy－seven＇）．Table 8 below depicts how often（number） words of different syllable lengths were used within the study．There are less stimuli with five syllables because there are less two－digit numbers whose numerals have five syllables．

Table 8：Quantity of stimuli with different syllable lengths

|  | Words | Numerals |
| :--- | :--- | :--- |
| Three syllables | 32 | 32 |
| Four syllables | 32 | 32 |
| Five syllables | 8 | 8 |

The words selected for the study were nouns．They were chosen to be as basic as possible so that participants would be able to semantically parse them．This is necessary for a fair comparison of words with Arabic digits because readers automatically know the semantics of，say，the digit 3 to be $\cdots$（quantity of three）when they parse it（Nuerk et al． 2015：Chapter 7：7；Willmes 2018：85）．The study＇s vocabulary corpus thus includes words like こころ kokoro＇heart＇，or なまえ namae＇name＇．Even if basic，words whose German（and English）translation is the exact same term as in Japanese were excluded from the corpus． This comprises Japanese loanwords such as karate，kimono，or tsunami．The longer the syllable length，however，the harder it is to find basic terms，which is why some selected words are more complex．For example，the word でんわばんごう denwa－bangou＇phone number＇is a compound of でんわ denwa＇phone＇and ばんごう bangou＇number＇（Okamoto 2005：59，211）．The noun はじまり hajimari ‘beginning’ is also not quite basic，because it is a nominalised form of the verb はじまる hajimaru＇to begin＇（Shibatani 2018：436－437）． However，every study participant had to learn these words on account of the curriculum of the University of Regensburg＇s Japanese courses．This is true for all terms used in the stimuli strings．To confirm that the participants truly understood every word，they had to translate them on a separate vocabulary list in the second phase of the study（more on which below）．

All words were presented in Hiragana script only．For this reason，no stimuli string hosted any modern loanwords，because these are typically written in Katakana（Dylman \＆ Kikutani 2018：504）．Even though it is technically possible to write the word konpyuuta ＇computer＇borrowed from English in both Katakana as コンピュータ and in Hiragana as こんぴゅうた，a Hiragana writing would be unusual（Tamaoka 2014：444）and therefore possibly lead to unwanted confusions about the word＇s semantics．That is not to say，however， that no loanwords were used at all．Historical loanwords from Chinese，such as おんがく ongaku＇music＇，were included because they have been incorporated into the native lexicon （Kess \＆Miyamoto 1999：15，198）．For some Japanese words，there is no preference on which script to use when writing them（Ukita et al．1991）．Two of these，namely めがね megane ＇glasses＇and えんぴつ enpitsu＇pencil＇，were used for the study．

Care was taken to present a variety of words．Within three－syllable，four－syllable，and five－syllable stimuli respectively，the onset syllable of each word was different：the onset ひ＜hi＞，for instance，only appeared once for three－syllable stimuli（in ひかり hikari＇light＇）， once for four－syllable stimuli（in ひきだし hikidashi＇drawer＇），and once for five－syllable stimuli（in ひるやすみ hiruyasumi ‘lunch break’）．Note that even though the onset syllable was different across the syllable－length groups，the onset mora was not necessarily．For example，the three－syllable words たんじょうび tanjoubi＇birthday＇and たまご tamago＇egg＇ both begin with the grapheme and mora＜た＞／ta／，but the onset syllable for tanjoubi is／tan／， not／ta／．As a corollary，the syllable lengths of each word used in the study did not automatically equal the number of graphemes or morae of said word．This is convenient inasmuch as it is expected that participants were thereby less likely to notice that words and numerals in each stimuli string had the same syllable length．The choice to have varied onsets for the word stimuli was made to ensure that reading delays would not just be a result of participants struggling with particular Hiragana characters．However，the onset variety is also one of the reasons why non－basic nouns had to be used in the study，because it restricted vocabulary choice when combined with the fact that each word had to have a particular syllable length while simultaneously being understandable for each participant．

Word variety was not just achieved through different onsets but also through semantic diversity．Namely，words in each stimuli string were selected to be semantically dissimilar． This means that even though the entire vocabulary corpus included，for instance，both the words しゅくだい shukudai ‘homework’ and きょうしつ kyoushitsu＇classroom＇，they were not presented next to each other．The reason for this lies in the idea that participants were not supposed to make syntactic connections via semantic similarity across any string．

Regarding the numbers used in the study，attention was given to ensure that single digits were not repeated as much as possible in each stimuli string．For example，in the stimuli string $36-51-74-82$ also depicted in example（3b）above，the digits $3,6,5,1,7,4,8$ ，and 2 only appear once each．This was，however，not possible for every stimuli string because of the way Japanese numerals are structured．As mentioned before，Japanese numerals for two－ digit numbers consist of nothing more than a number word for any single digit between 1－9， the multiplier word じゅう juи＇ten＇，and then another number word for any single digit between 1－9（Dehaene 1992：4）．This means that almost every two－digit numeral has three free morphemes．${ }^{13}$ Table 9 shows the syllable lengths for each of the numbers between 1－10．

[^10]Table 9：Quantity of syllables in Japanese numerals corresponding to the numbers 1－10．The period is used to indicate a syllable break．

|  | Japanese number word |  |  |
| :---: | :---: | :---: | :---: |
| Number | Hiragana | Romanised | Syllables |
| 1 | いち | $i . c h i$ | 2 |
| 2 | に | $n i$ | 1 |
| 3 | さん | san | 1 |
| 4 | よん（or：し） | yon（or：shi） | 1 |
| 5 | ご | go | 1 |
| 6 | 弓く | ro．ku | 2 |
| 7 | なな（or：しち） | na．na（or：shi．chi） | 2 |
| 8 | はち | ha．chi | 2 |
| 9 | きゅう | kyuu | 1 |
| 10 | じゅう | juu | 1 |

For the creation of a numeral with three－syllables，only individual morphemes with one syllable each therefore come into question．For example，combining に ni＇two＇with じゅう juи＇ten＇and さん san＇three＇creates the three－syllable numeral にじゅうさん ni－juu－san ＇twenty－three＇．In the case of four－syllable numerals，either the slot for tens or the slot for units within a number has to be filled with a two－syllable morpheme．A combination of，for instance，はち hachi ‘eight＇with じゅう juu＇ten＇and よん yon＇four＇creates the four－syllable numeral はちじゅうよん hachi－juu－yon＇eighty－four＇．For five－syllable numerals，both the slot for tens and the slot for units has to be filled with a two－syllable morpheme．An example here is ななじゅういち nana－juu－ichi＇seventy－one＇，which is a combination of ななnana＇seven’ with じゅう juu＇ten＇and いち ichi＇one＇．All of this is to say that there are only limited options for combining digits when aiming at the creation of numerals with specific syllable lengths．Therefore，despite trying not to repeat individual digits within stimuli strings，there were a few stimuli strings that had one or more duplicates．The most extreme case is depicted in example（4），where the digit 8 appears thrice，and the digit 7 appears twice．However，the last two stimuli in all strings，for example $81-67$ in（4），never had digit duplicates．In the $t$－tests for switch cost，only those last two stimuli were used in all cases（see $\S 5.8$ ）．
（4）Stimuli string with repeated digits 86 $78 \quad 81$ 67

For the purpose of testing for switch cost，the last two stimuli NW of the NNNW type and the last two stimuli WN of the WWWN type were of main concern．Here，too，it was ensured that the numbers prompted were as varied as possible．Since every stimuli type consisted of exactly nine stimuli strings，both the slot for tens and the slot for units of each
number could be equipped with all Arabic digits from 1-9 throughout. This was done to ensure that participants would have to read a variety of numbers so that delays would not just arise from a participant struggling with particular digits. The digit 0 was not needed since it is neither pronounced separately in the number 02 nor in 20 . Figure 9 displays the last two stimuli WN of all nine stimuli strings in the WWWN type. For the tens, the digits 1-9 are shown in ascending order, while for the units, the digits 1-9 are spread across. The originally Japanese words are only presented in their English translations, but they can be found in Appendix B I.

| evening | 16 |
| :---: | :---: |
| building | 28 |
| pencil | 39 |
| desk | 42 |
| happiness | 57 |
| lightning/thunder | 64 |
| lunch break | 71 |
| washing machine | 83 |
| rear, back | 95 |

Figure 9: The last two stimuli of all nine stimuli strings in the WWWN stimuli type. Both tens and units are equipped with the digits 1-9 throughout.

### 5.5 Design

For the first phase of the study, the stimulus material was transferred onto PowerPoint Presentation slides, with one slide for one stimuli string. At the very start, a slide with a fixation cross was added to assure that participants would only be able to see the first stimuli string after clicking to the next slide. A fixation cross was also added after a block of nine different stimuli strings. It allowed participants to take a break of at most 10 seconds.

Each block of nine stimuli strings consisted of two strings of the WWWW type, two of the WWWN type, two of the NNNN type, and two of the NNNW type. The leftover, ninth slide was given to another stimuli string of any of these types. This means that after four blocks of stimuli strings, all 36 strings were utilised. Within each stimuli block, the stimuli strings were put into a random order so that participants would not always read, for example, an NNNN stimuli type after a WWWW type.

The order of slides with stimuli strings was also randomised multiple times, resulting in five different PowerPoint Presentations. Therefore, only every sixth participant read the stimuli strings in the same order as another participant. This was conceptualised to ensure that reading delays on any slide were not overly influenced by, say, delays caused by a difficult (number) word on the prior slide. Despite the five different randomisations, each block of
nine stimuli strings in every variation had four strings with three－syllable stimuli，four strings with four－syllable stimuli，and one string with five－syllable stimuli．

Both the font and font size on all slides was the same：all Hiragana words were in MS PGothic 26p，while all numbers were in Arial 26p．Between each word and／or number，there were five spaces．Figure 10 displays one slide with one stimuli string its original format．


Figure 10：The stimuli string ところ tokoro＇place＇－ねずみ nezumi＇mouse／rat＇－つくえ tsukue＇desk＇－ 42 in the font and size used on the PowerPoint Presentation slides

For the second phase of the study，i．e．，the vocabulary test，all 72 words used on the slides were converted into a simple list．Only one list was used for all participants and the word order was not the same as on any of the five PowerPoint Presentation variations．The task read（in German）：Please translate the words you know into German or English．The list can be found in Appendix B II．

## 5．6 Procedure

The study was conducted in a separate，quiet location．After signing the form of consent，each participant was asked to read aloud a test version of the study displayed via PowerPoint Presentation slides on a tablet．This test version consisted of one example slide for each of the stimuli types，but no stimuli string that would be used in the actual study．Once successfully completed，phase one of the study began．

I initiated an audio recording on both the tablet as well as a phone and chose one of the five PowerPoint Presentation variations．The participants had to read aloud each slide from left to right．In order to move onto the next slide，they used the spacebar on a keyboard situated between them and the tablet．After each block of nine slides，participants could rest for ten seconds，but they were able to turn to the next slide at any time．Phase two of the study consisted of a written vocabulary test．Participants had to translate every word they had read on the slides into German or，if desired，into English．This was not conducted on the tablet but using a printed version of the list of all 72 words．

## 5．7 Collection of data

The audio recordings taken during the study were used to measure every intermission between every stimulus of every stimuli string．For example，for the stimuli string seen in example（5），it was tested how long it took each participant from first seeing the slide to saying 65 ，from 65 to saying 27 ，from 27 to saying 84 ，from 84 to saying びじゅつかん bijutsukan＇museum＇，and from＇museum＇to clicking to the next slide．In－word delays and mistakes，both for words and numerals，were also measured and marked，but not used for statistical analysis in this work（see Appendix B III for the full collection）．Intermissions and delays will mostly be referred to as response time（RT）in the following．
（5）Select stimuli string
65
27
84
びじゅつかん
bijutsukan
＇museum＇

In simple circumstances，RTs were measured using a Praat script for automatically marking silences developed by Lennes（2017）．However，in a lot of cases，manual measurements were necessary because participants did not have clear breaks between one （number）word and the next．Breaks were instead filled with uhs and erms，the onset of the next stimulus＇syllable was started but then repaired，or the coda of one stimulus and the onset of the next amalgamated．Examples（6）to（8）depict these breaks as enunciated by actual study participants using the Jefferson transcription system．In each example，（a）shows an instance with words while（b）shows an instance with numbers．The Japanese word stimuli are only given in their English translation for convenience．Note also that the filler words $u h$ and erm in（6）were originally said in German－that is，as äh＇uh＇and ähm＇erm＇－since the study participant＇s native tongue is German．More types of breaks are discussed in §7．
（6）Addition of filler words between two stimuli

```
a. Subject 4: office (1.3) erm: (.)
    refrigerator
b. Subject 1: fifty five (.) uh:: (0.5)
    ninety four
```

（7）Repair of the onset of the latter stimulus（even though no mistake was made）
a．Subject 16：meeting arrangement（1．1）
lunch－（0．6）lunch break
b．Subject 10：ninety six（3．4）
four＝forty seven
(8) Pronunciation of both stimuli with no delay at all
a. Subject 11: woman=summer festival
b. Subject 5: seventy eight=eighty one

So, considering that multiple speech patterns disrupted Lenne's (2017) script, the silent intervals indicated in brackets within example (6) to (8) do not equal the full RTs participants had between the coda of the last stimulus and the onset of the next. For instance, in (6b), the full RT between the number words fifty-five and ninety-four was measured to be 0.7 seconds by combining the small break (.), the time it took to utter the filler word $u h$, and the delay of 0.5 seconds indicated in brackets. The full RT between the words 'meeting arrangement' and 'lunch break' in (7a) includes the initial 1.1 seconds delay, the time it took to utter the cut-off attempt 'lunch', and the following delay of 0.6 seconds, thus combining to 1.9 seconds of RT. In example (8), both RTs amount to 0 seconds because there was no delay at all.

For the second phase of the study, i.e., the written vocabulary test, it was analysed whether participants were familiar with the semantics of the words they had just read on the slides. Words left untranslated and words translated incorrectly were both marked as the participant not knowing their meaning.

### 5.8 Data analysis

Statistical Package for the Social Sciences (SPSS) was used for the analysis of whether participants had a significant switch cost, i.e., significantly long RTs when reading aloud a word stimulus after a number stimulus or when reading aloud a number stimulus after a word stimulus. Out of all data collected (see Appendix B III), all of the following statistical tests were carried out using only the RTs of the latter part of each stimuli string. That is, in $\mathrm{WWW} \mid \mathrm{N}$, the RT between $\mathrm{W} \mid \mathrm{N}$ was used, in NNN|W, the RT between $\mathrm{N} \mid \mathrm{W}$ was used, in NNN|N, the RT between N|N was used, and in WWW|W, the RT between $\mathrm{W} \mid \mathrm{W}$ was used for data comparison (with | here, but not in the following, marking the measured RT for better understanding). However, all results obtained via just the latter part of every string will be treated within the context of their entire stimuli type. It was possible to work with the data of all $n=18$ participants. For the assessment of inner-group effects and between-group effects, parametric $t$-tests were applied by supposing a statistical effect as significant if $p$ did not exceed 0.05 and as very significant if $p$ did not exceed 0.001 . Additionally, effect sizes (Cohen's $d$ ) were calculated by defining an effect size of $d \leq 0.3$ as a small effect, and an effect size of $d \geq 0.7$ as a large effect size.

## 6. Results

### 6.1 Response time by stimuli type

Across all four different stimuli types, no significant difference in RTs was found, with the means $M$ for each type being $M(\mathrm{WW})=0.8975, M(\mathrm{NN})=0.8511, M(\mathrm{NW})=0.9372$, and $M(\mathrm{WN})=0.9202$. Effect sizes were low (Cohen's $d \leq 0.3$ ) for all RT comparisons. In this analysis, the nuisance parameters of different language proficiency of the participants, different syllable lengths of the stimuli, and different total quantity of three and four-syllable stimuli ( $n=64$ each) versus five-syllable stimuli ( $n=16$ ) were included, i.e., not accounted for. Figure 11 compares the mean RTs in seconds for the four different stimuli types. Even just visually, the bar sizes do not differ by much.


Figure 11: Mean response time between the coda of the last (number) word and the onset of the following (number) word for the four different stimuli types in seconds

### 6.2 Response time by stimuli type and language proficiency

A comparison of the mean RTs based on the participants' language proficiency across different stimuli types also did not yield any statistical significance per se. However, there are much higher effect sizes, meaning that statistical significance would likely appear with a higher number of study participants. The level-dependent mean RTs for each stimuli type are displayed in Table 10.

Table 10: Mean response time between the coda of the prior (number) word and the onset of the next (number) word based on the participants' language proficiency level in seconds

|  | Language proficiency level |  |  |  |  |  |  |
| :--- | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | $\mathbf{0}$ |  | $\mathbf{1}$ |  | $\boldsymbol{M}$ | $\mathbf{2}$ |  |
|  | $\boldsymbol{M}$ | $\mathbf{S D}$ | $\boldsymbol{M}$ | SD | $\boldsymbol{M}$ | SD |  |
| WWWW | 0.8908 | 0.46 | 0.7162 | 0.32 | 1.0894 | 0.39 |  |
| NNNN | 1.0463 | 0.51 | 0.7292 | 0.28 | 0.6609 | 0.23 |  |
| NNNW | 1.0303 | 0.39 | 0.8419 | 0.35 | 0.8837 | 0.56 |  |
| WWWN | 1.0677 | 0.36 | 0.8011 | 0.25 | 0.8033 | 0.21 |  |

Notation: $M=$ mean response time, $\mathrm{SD}=$ standard derivation

Figure 12 below is a conversion of Table 10 into a bar graph. It can be seen that the lowest language proficiency group 0 had the longest mean RTs for all stimuli types. The only exception to this is the WWWW stimuli type, in which it was the highest-level proficiency group 2 who had the longest RTs.

Influence of language proficiency on mean response time


Figure 12: Bar graph of the mean response time between the coda of the prior (number) word and the onset of the next (number) word based on the participants' language proficiency level in seconds

As mentioned above, there are effect sizes in the mid-range (Cohen's $d \geq 0.5$ ) or highrange (Cohen's $d \geq 0.7$ ) when accounting for language competency. Table 11 shows all effect sizes when comparing the mean RTs of the participants' different proficiency levels. In the WWWW stimuli type, the different RT spans between participants of the lowest-level Japanese proficiency 0 and the middle-level proficiency 1 are considerable (Cohen's $d=0.5$ ). That is, level 0 speakers have considerably longer delays between the coda of the last word
and the onset of the next word than level 1 speakers. This is also true in a comparison of the levels 0 and 2 within the same stimuli type (Cohen's $d=0.5$ ). Comparing the levels 1 and 2 for the WWWW stimuli type, the delays are even more substantial (Cohen's $d=1.2$ ). It is the highest effect size across the board. By referencing Figure 12, it is possible to see, however, that it is not level 1 with longer RTs, but counterintuitively the higher level 2. For the NNNW stimuli type, only a comparison of the levels 0 and 1 yielded a considerable effect size (Cohen's $d=0.5$ ). Specifically, level 0 participants had longer RTs. Very substantial effect sizes arose in a comparison of level 0 and 1 as well as level 0 and level 2 for both the NNNN stimuli type (Cohen's $d \geq 0.7$ ) and WWWN stimuli type (Cohen's $d=0.8$ ). In all cases, level 0 participants had very substantially longer RTs between the coda of the last stimulus and the onset of the next.

Table 11: Effect sizes when accounting for the participants' language competency levels. A mid-range Cohen's $d$ is highlighted in light grey (considerable effect size), whereas a highrange Cohen's $d$ is highlighted in dark grey (very considerable effect size).

|  | Effect sizes Cohen's $\boldsymbol{d}$ |  |  |
| :--- | :---: | :---: | :---: |
|  | when comparing the proficiency levels: |  |  |

### 6.3 Response time by stimuli type and syllable length

A comparison of the mean RTs needed for all stimuli with various syllable lengths produced statistically significant differences. Table 12 displays the mean RTs of (number) words with different syllable lengths in seconds. The mean RT between the coda of the former threesyllable word and the onset of the following three-syllable word within the WWWW stimuli type, for example, was $M=0.8883$ seconds.

Table 12: Mean response time between the former (number) word and the onset of the following (number) word for different syllable lengths in seconds

|  | Mean response time in seconds <br> between words and number words with: |  |  |
| :--- | :---: | :---: | :---: |
|  | three syllables | four syllables | five syllables |
| WWWW | 0.8883 | 0.8156 | 1.2615 |
| NNNN | 0.9702 | 0.7984 | 0.5862 |
| NNNW | 0.7017 | 1.0805 | 1.3065 |
| WWWN | 0.8098 | 1.0014 | 1.0371 |

Figure 13 below is the data of Table 12 turned into a bar graph. It can be seen that in most cases, the longer the syllable length of a (number) word, the longer the mean RT becomes. This result is, however, reversed for the NNNN stimuli type.


Figure 13: Bar graph of the mean response time between the former (number) word and the onset of the following (number) word with different syllable lengths (three to five syllables) in seconds

As mentioned above, the study used less five-syllable stimuli ( $n=16$ ) than threesyllable ( $n=64$ ) and four-syllable stimuli ( $n=64$ ). For reasons of comparability, the following paired $t$-tests therefore exclude five-syllable stimuli. A few mid to high effect sizes (Cohen's $d \geq 0.5$ ) and standard statistical significances ( $\mathrm{p}<0.05$ ) arise when comparing the mean RTs between stimuli within the same stimuli type but with different stimuli syllable lengths each. Namely, a comparison of three-syllable stimuli of the NNNW type and threesyllable stimuli of the NNNN type reveals that the mean RTs between the coda of the prior (number) word and onset of the next (number) word was significantly shorter for threesyllable stimuli of the NNNW type, $t(17)=2.587, \mathrm{p}=0.0192(<0.05)$, Cohen's $d=0.6$, $\mathrm{SD}=0.44$. Comparing four-syllable stimuli of the WWWW type and four-syllable stimuli of the NNNW type presents significantly shorter mean RTs between two stimuli of four-syllable length for the WWWW type, $t(17)=-3.559, \mathrm{p}=0.0024(<0.05)$, Cohen's $d=0.8, \mathrm{SD}=0.32$. In a comparison of the RTs between four-syllable stimuli of the NNNN type and four-syllable stimuli of the WWWN type, results show that RTs were significantly shorter for four-syllable stimuli of the NNNN type, $t(17)=-2.410, \mathrm{p}=0.028(<0.05)$, Cohen's $d=0.6, \mathrm{SD}=0.36$.

Rather than viewing different types but same syllable length, it is also possible to compare the mean RTs within the same stimuli type but with different syllable lengths. Here, standard statistical significance ( $\mathrm{p}<0.05$ ) was found when comparing the mean RTs between
two three－syllable stimuli and two four－syllable stimuli of the NNNN type，$t(17)=2.390$ ， $\mathrm{p}=0.0287(<0.05)$ ，Cohen＇s $d=0.6, \mathrm{SD}=0.31$ ．RTs were significantly shorter for four－ syllable stimuli，which is counterintuitive．Considerable statistical significance（ $\mathrm{p}<0.001$ ） arose for a comparison of three－syllable stimuli and four－syllable stimuli of the NNNW type， $t(17)=-5.673, \mathrm{p}=0.00003(<0.001)$ ，Cohen＇s $d=1.3, \mathrm{SD}=0.28$ ．Here，RTs were significantly shorter for three－syllable stimuli．All of these results can be cross－referenced in Figure 13．However，since the $t$－tests did not include five－syllable stimuli，Figure 14 below displays the same results with just three－syllable and four－syllable stimuli for better readability．


Figure 14：Bar graph of the mean response time between the prior（number）word and the onset of the next（number）word with different syllable lengths（three to four syllables）in seconds．It is identical to Figure 13，except that five－syllable stimuli were excluded．

## 6．4 Vocabulary error rate

Regarding phase two of the study，where every participant had to translate all 72 Japanese words used on the PowerPoint Presentation slides into German or English，it was found that a mean of $M=7.94$ words was not translated at all，while a mean of $M=4.22$ words was translated incorrectly．Therefore，a rounded－up mean of $1 / 6$ of all words was unknown to the participants．Further，for a total of 4 words，more than half of the participants were unable to correctly identify their respective meanings．This is the case for まちあわせ machiawase ＇meeting arrangement＇（ $n=12$ participants did not know），にわとり niwatori＇chicken’ （ $n=13$ ），くちびる kuchibiru＇lips＇（ $n=14$ ），and おくりもの okurimono＇gift＇$(n=15)$ ． However，this did not affect the participants＇ability to read each word aloud．

## 7. Discussion: results in relation to processing models

### 7.1 Switch cost hypothesis

The present study was conducted in order to examine whether switching between words and Arabic multi-digit numbers in a reading task would lead to a time cost, i.e., significantly longer delays, in comparison to reading aloud word after word or number after number stimuli (hypothesis (1)). This switch cost was anticipated to appear because of different cognitive processes subserving the task of reading words aloud on the one hand and the task of reading multi-digit numbers aloud on the other hand, even when disregarding the difficulty of the script(s) or number system(s) utilised by a language. There is at most minor to moderate evidence for hypothesis (1).

The only statistically significant differences in mean response times (RTs) were between the coda of the prior stimulus and the onset of the next stimulus in three different scenarios: first, in a comparison of four-syllable stimuli of the WWWW type and foursyllable stimuli of the NNNW type, RTs were shorter for the WWWW type. Second, comparing four-syllable stimuli of the NNNN type and four-syllable stimuli of the WWWN type, RTs were shorter for the NNNN type. Both of these cases advocate for a switch cost inasmuch as switching between words and numbers (and vice versa) caused the study participants to have longer delays than when reading sequences of either only words or only numbers. However, third, comparing three-syllable stimuli of the NNNW type and threesyllable stimuli of the NNNN type, RTs were shorter for the NNNW type. This goes against the switch cost hypothesis, since switching between a number stimulus and a word stimulus had shorter delays than staying in the same number domain.

This raises the question whether different cognitive models are actually necessary to explain number-processing on the one hand and word-processing on the other. That is, do the dual-route cascaded (DRC) model and the parallel-distributed-processing (PDP) model already suffice to explain the reading of Arabic multi-digit numbers without needing separate interpretations? If so, there would be no need to judge whether a switch cost is caused by differing cognitive processes. However, neither the DRC model nor the PDP model are adequate for explaining number-reading. The DRC model cannot account for number-reading, because of two distinct reasons. Firstly, the lexical route used for whole-word look-up procedures is unproductive for numbers, inasmuch as the phonological form of numerals is not stored in the (same) mental dictionary as content words (see §3.2.2.2). Rather, number words, multiplier words, and, if present, function words within a numeral each have to be retrieved from separate stores for a "manual" assembly (Dotan \& Friedmann 2018: 25). This
means that the phonological form of content words is ready to be retrieved in its entirety， while the phonological retrieval of numerals requires extra steps not depicted in the DRC model．Secondly，the non－lexical route used for grapheme－to－phoneme correspondences in words is entirely ineffective for Arabic digits，because a number like 23 does not give phonetic information but semantic information．Even if the digit 2 was seen as a grapheme for $/ t u: /$ ，and the digit 3 as a grapheme for／$\theta$ ri：／，the indirect route would still be unable to parse both of them together as a tens－digits combination，where 2 then needs to be read as／twenti／．

The fact that the phonological form of multi－digit numbers is neither retrieved in its entirety nor retrieved by imagining the numeral＇s written－out graphemes for a letter－by－letter reading can be underlined when looking at the numerical reading performance of the participants of the present study．Here，the simple number system of Japanese allowed for a clear digit－by－digit reading：a number could be read from left to right one digit at a time without having to think about，say，the inversion of the tens and digits．This translated into participants being able to＂take breaks＂in form of short delays after each digit．Example（9） shows an instance of in－numeral delays．The numeral ろくじゅうなな roku－juu－nana＇sixty－ seven＇is not retrieved in its entirety，because then delays inside the number word would not be necessary at all．It is also not read by imagining each grapheme of the numeral，because then the delays would not conveniently fall between morphemes．That is，delays would instead frequently split，for example，the morpheme ろく roku＇six＇into its syllables／ro－／and $/-\mathrm{ku} /$ ．This sort of morpheme－break within numerals，while existent，was rare in the study （ $n=10$ ）．A mora like／ro／，however，was never split into its components $/ \mathrm{r}-/$ and $/-\mathrm{o} /$ ．Most commonly，participants took an in－numeral break after the multiplier word じゅう juи＇ten＇， i．e．，when they had to think of the number word for the unit position（see Appendix B III）．
（9）In－numeral delay
Subject 3：roku（0．3）juu（0．4）nana
ろくじゅうなな
roku－juи－nana
six－ten－seven
＇sixty－seven＇
The PDP model gets much closer to being able to account for number－reading．As long as a digit is seen as an orthographic entity，its abstract orthographic units could be turned into semantic units（the quantity a number represents）and then be turned into phonological units（the phonological form）．In fact，the PDP model can be directly juxtaposed with the triple－code model．Figure 15 below depicts the PDP model for reading words on the left（a）， and the triple－code model for number－processing in general on the right（b）．Both models are
triangular and have bilateral connections. They are even structured the same way: in both cases, the lower left shape represents visually parsed signs (orthography and digits), the upper shape represents semantics (word meaning and number quantity), and the lower right shape represents speech.

a. PDP model for word-reading

b. Triple-code model for number-processing

Figure 15: Seidenberg \& McClelland's (1989) parallel-distributed-processing model (a) adapted from Plaut et al. (1996: Figure 1) and the triple-code model (b) adapted from Dehaene (1992: Figure 5) side by side

However, the two models are not entirely congruent. This makes sense when considering that each code of the triple-code model exists to explain a wide range of number-specific tasks, such as parity judgements, magnitude comparisons, or subitising (Dehaene 1992). Yet even when comparing the two models only based on the task of digit-to-numeral reading, the PDP model and the triple-code model differ on their bilateral connections. Firstly, the focus on a "similarity-based activation process in conjunction with a frequency-sensitive connection weight adjustment process" (Plaut et al. 1996: 100) for connection pathways in the PDP model is not only absent in the triple-code model, but it is also not needed. While letters, especially in English, can have widely different pronunciations based on context or orthographic inconsistencies, digits are always pronounced the same way. The system therefore has nothing to adjust or learn. Secondly, while the semantic pathway in the PDP model allows for semantic units to be turned into phonological units (Plaut et al. 1996: 100), the triple-code model considers the magnitude-to-numeral transcoding path ineffective. That is, the analogue magnitude code "does not contain a replication of the syntactic rules for composing any well-formed verbal numeral" (Dehaene 1992: 32). The only effective transcoding path when reading an Arabic digit aloud is therefore the path between the visual code and the auditory verbal code (Dehaene 1992: 32). On the other hand, for Arabic digits to
be readable via the PDP model, they would have to propagate along the semantic pathway because the phonological pathway cannot turn symbols lacking phonetic information into speech sounds (Plaut et al. 1996: 100). Thirdly, by being a model for word-reading, the PDP model is unable to account for multiple uniquely numerical sub-processes associated with digit-to-verbal transcoding. These at least consist of triplet parsing, zero encoding, and digitbinding (see §3.2.2).

Since the DRC model is not sufficient for number-reading, and the PDP model is not entirely applicable to the assumed innerworkings of numerical cognition as proposed by the triple-code model, the idea that two different processes activate for reading aloud a word and for reading aloud a number respectively is not inconceivable. However, the different processes do not seem to be so work-intensive as to become discernible in the form of a switch cost. Fittingly, even when it comes to general brain regions involved in reading words and numerals aloud, no stark differences can be found on the superficial level of this work. Both letters and digits are visually parsed through occipitotemporal regions, although the right caudal fusiform gyrus might only activate for symbolic notations of numbers, such as Arabic digits (Plodowski et al. 2003: 2046; Skagenholdt et al. 2018: 4). In speech, both words and numerals engage the left-hemispheric perisylvian language network because Arabic multidigit numbers have already been transcoded into the language-based auditory verbal code by this step. However, while "the reading of words and pseudowords is largely left lateralised", there is minor evidence that "the processing of numbers follows a right lateralised pathway" (Carreiras et al. 2015: 8). The left hemisphere associated with language processing has further been demonstrated to be less attuned to numerical symbols than to letter strings (Carreiras et al. 2015: 8). More precise information may be found when examining different types of brain lesions associated with, say, aphasia or dyscalculia (e.g., Anderson et al. 1990), but this exceeds the scope of this work.

### 7.2 Comparing the difficulty of word-reading and number-reading

In hypothesis (2), it was assumed that delays when reading a number followed by a word (NW) were shorter than when reading a word followed by a number (WN). That is, reading numbers should generally be harder than reading words. This assumption derived from the sub-assumption that reading delays between two words are shorter than reading delays between two numbers because of three separate reasons. Firstly, words are read more frequently than numbers (2)a). Secondly, words can be read both semantically and phonetically, whereas numbers can only be read semantically (2)b). Thirdly, since erroneously used letters within words do not affect the semantics as much as using erroneous
digits in numbers，participants should be more careful in pronouncing numbers（2）c）．To give an example for the last point，if a speaker said＊reizouku instead of れいぞうこ reizouko ＇refrigerator＇，the word＇s meaning would likely not be lost in a conversation．Yet，if instead of にじゅうさん ni－juu－san＇twenty－three＇，a speaker said にじゅうよん ni－juu－yon＇twenty－ four＇，the meaning would change entirely．However，as turns out，mean RTs between two words were slightly higher with $M(\mathrm{WW})=0.8975$ seconds than the mean RTs between two numbers with $M(\mathrm{NN})=0.8511$ seconds，although the difference between these values is not statistically significant．This means that words were not read faster than numbers．In line with this finding，$M(\mathrm{NW})=0.9372$ is not lower than $M(\mathrm{WN})=0.9202$ ，thus rendering hypothesis（2）incorrect．

To comment on why this might be the case，the sub－hypotheses need to be re－ examined．The idea that words are read more often than numbers（sub－hypothesis（2）a）should intuitively hold true．For example，despite this work being about numbers，the quantity of word tokens is still higher．When looking at word types，out of the top hundred most frequent words in，for example，English，only two are number words：the number word one and two （Word frequency data 2022）．Sub－hypothesis（2）b also holds true－at least according to the DRC model．Words can be read semantically along the lexical route and phonetically along the non－lexical route．Numbers have no phonetically readable components and can therefore only be read semantically．The dual firing of both the lexical and non－lexical route should increase reading speeds for Hiragana words in comparison to numbers．However，it seems that the reading of words was slower than that of numbers in the present study precisely because words were written in Hiragana．That is to say two things．Firstly，the Hiragana script is less familiar to the study participants than Latin script，allowing for more delays between the reading of two words．

Secondly，even though Hiragana enabled participants to read words phonetically，it might have inhibited them semantically．This is because most words prompted in the study are not actually frequently encountered in Hiragana，but instead in the logographic script Kanji（or as a Kanji－Hiragana combination）．For example，the word shokudou＇dining hall＇is generally seen in Kanji 食堂 rather than in Hiragana しょくどう．The compound 食堂 （食＇food＇＋堂＇hall＇）only allows for a semantic reading，thus forcing access to the mental dictionary of the fast－reading lexical route（Kess \＆Miyamoto 1999：200－204；Okamoto 2005： 85，295）．The Hiragana version しょくどう shokudou＇dining hall＇can be read along both the faster lexical route and the slower non－lexical route，but it is likely that participants did not grasp semantics fast enough to counterbalance activation along the non－lexical route． Example（10）shows an instance，in which Subject 18 seemingly only grasped the meaning of
the word えきまえ ekimae＇front of the train station＇after reading it incorrectly as＊enkimae for the first time．
（10）Hiragana causing slower semantic understanding
Subject 18：enkimae（1．8）${ }^{\circ}$ e个ki－․ A个：eki $\downarrow$ mae

えきまえ
eki－mae
train．station－front
＇front of the train station＇

The fact that participants struggled with word semantics is further supported by the anecdotal evidence that most of them＂complained＂about having to translate Hiragana words rather than Kanji characters in the vocabulary translation part of the study．Note，however，that this untimed translation phase gave participants enough time to think about semantics even without Kanji，which is why most words were translated correctly（see §6．4）．

So，even if words are generally read more frequently than numbers，Japanese words－ and especially words presented in disfavoured Japanese scripts－might be encountered less than Arabic multi－digit numbers by foreign language learners，thus rendering sub－hypothesis （2）a incorrect．Further，even if Hiragana words can technically be read both by phonetic processes and by semantic processes，this does not mean that they really were．Sub－hypothesis （2）b thereby loses ground as well．Subsequently，the variable of script－familiarity appears to be a more consequential factor in linguistic－numerical reading than the entire cognitive effort involved in transcoding between the visual code（digits）and the auditory verbal code （numerals）．This makes sense considering the possibility to read Japanese multi－digit numbers digit－by－digit．

The expectation that participants would have longer delays before numbers than words because mistakes have more negative effects on numerical semantics（2）c）appears to be half－true．Participants were indeed careful in the pronunciation of numbers，but this did not translate into delays between the coda of the prior stimulus and the onset of the next stimulus． Instead，they had a different strategy for spending more time to process numbers，which was omitted in the $t$－test calculations of this work：participants took breaks while uttering numerals rather than before uttering them．To be exact，the total quantity of in－numeral breaks was $n(\mathrm{~N})=192$ in comparison to just $n(\mathrm{~W})=87$ in－word breaks．Example（11a）shows an instance of two delays within the word びじゅつかん bijutsukan＇museum＇，while（11b）shows an instance of two delays within the numeral にじゅうご ni－juu－go＇twenty－five＇．None of these delays were accounted for in the $t$－tests．
（11）In－word and in－numeral delays
a．Subject 14：bi（0．3）ju（0．2）tsukan
びじゅつかん
bijutsukan
＇museum＇
b．Subject 1：ni（0．2）juu（0．3）go
にじゅうご
ni－juи－go
two－ten－five
＇twenty－five＇

The fact that number－reading was better than word－reading in the present study directly contradicts the study results of Rath et al．（2015）．In their experiments，aphasic German speakers had better numerical performances in a wide range of tasks，except for the task of reading words versus Arabic digits．That is，the study participants of Rath et al．（2015） were slower when reading numbers．It was assumed that slower number－reading speeds derived from the more complex number system employed by German（Rath et al．2015：17； also see §5．2．2）．However，within the scope of this work，the effect of the complexity of a number system on switch cost was not tested．

## 7．3 Influence of syllable length and language proficiency on reading delays

In hypothesis（3），it was expected that delays between two stimuli would be greater the longer their syllable－length．There is conflicting evidence．When comparing two three－syllable stimuli and two four－syllable stimuli of the NNNW type，the mean RT between three－syllable stimuli was significantly shorter．This is in line with the intuition that numerals with more syllables take longer to process．It was the most statistically significant finding of the study． However，counterintuitively，when comparing two three－syllable stimuli and two four－syllable stimuli of the NNNN type，RTs were significantly shorter for four－syllable stimuli．The reasons for this are unclear．

In hypothesis（4），it was further anticipated that delays between two stimuli would be greater the lower the proficiency level of a participant because lower levels had less experience with the Japanese language．This mostly appears to be the case．For the NNNN type，the WWWW type，and the WWWN type，level 0 participants had considerably longer delays than level 1 or level 2 speakers．For the NNNW type，level 0 speakers only had considerably longer delays than level 1 speakers，but not level 2 speakers．Thus，level 2 speakers counterintuitively had longer mean RTs than the level 1 speakers below them．This is also the case for the WWWW type，where level 2 speakers had considerably longer RTs
than level 1 speakers. It appears that level 2 speakers, despite being the highest level in the study, struggled with the enunciation of words. Two reasons can explain this: firstly, the higher the Japanese proficiency level, the more Kanji characters are used instead of Hiragana characters. Authentic sentences necessitate semantic readings of the Kanji logograms rather than phonetic readings of Hiragana. Therefore, confidence in Hiragana might decrease over time. Secondly, $n=3$ out of $n=5$ level 2 speakers had already graduated the final Japanese course multiple semesters before the study. In case these participants did not continue to actively exercise Japanese scripts without Japanese lessons, their familiarity with Hiragana might have declined.

## 8. Conclusion

This work aimed at expanding the research on switch cost into the field of linguisticnumerical cognition. Different models were examined to see how cognitive processes of reading words aloud versus reading numbers aloud are theorised to differ. For word-reading, this included the opposing dual-route cascaded (DRC) model by Coltheart (1978) and the parallel-distributed-processing (PDP) model by Seidenberg \& McClelland (1989). The DRC model suggests that the phonological form of words can be retrieved via two distinct routes (§3.1.1). The lexical route allows for known words to be recognised quickly and to be searched for in a mental dictionary. The non-lexical route is used for manually assembling the phonological form of pseudowords or words with irregular orthography by applying language-dependent sound rules in so-called grapheme-to-phoneme correspondences. On the other hand, the PDP model suggests that the phonological form of all different kinds of words can be retrieved with a singular cognitive mechanism (§3.1.2). Namely, phonological retrieval is achieved by constantly comparing patterns of activity propagated along the connecting pathways between neuron-like semantic, orthographic, and phonological processing units. This "comparison" is an act of statistically weighing pieces of information about the correct pronunciation of letters in different contexts against each other.

For number-reading, the examined models included the triple-code model by Dehaene (1992) and the model for multi-digit reading by Dotan \& Friedmann (2018). The latter is not in opposition to the triple-code model, but rather functions as an in-depth exploration of digit-to-numeral conversions also found in the triple-code model. In the triple-code model, it is assumed that three different cognitive representations, or codes, subserve all tasks associated with numbers (§3.2.1). Firstly, the analogue magnitude code is necessary to understand numerical quantity. It is language-independent and has been proven to exist in non-human animals as well. Secondly, the visual code is activated when manipulating symbolic
representations of numbers, such as Arabic digits. The visual recognition of numbers as well as most arithmetic operations are subserved by this code. Thirdly, the auditory verbal code exists to manage numbers on a linguistic plane: i.e., this code enables auditory understanding of numbers, as well as the naming and reading of numerals. In order to turn an Arabic digit into a numeral, transcoding between the visual code and the auditory verbal code is necessary. The model for multi-digit reading functions as a closer analysis of exactly this process (§3.2.2). Specifically, transcoding requires a multitude of sub-processes, such as parsing the digit identity, the digit order, the length of the number, the position of triplets, the position of the digit 0 , and the number's hierarchical structure. This information is then translated into number word frames, i.e., the foundational structure of numerals. Only afterwards is a speaker able to utter each digit in the correct order imposed by the numeral system of a language.

It was found that the reading aloud of Arabic digits can neither be explained with the DRC model nor the PDP model for reading (§7.1). The symbolic nature of digits cannot be accounted for with the DRC model. Cognitive mechanisms unique to numbers, such as tripletparsing, can also neither be accounted for by the DRC model nor the PDP model. The present study then intended on discovering whether the different cognitive processes proposed for word-reading on the one hand and number-reading on the other hand would also reveal themselves in the form of speech delays (§5). That is, is there a time cost for switching between reading words versus numbers in comparison to reading sequences of just words or just numbers? In order to explore this question, $n=18$ German learners of Japanese were tested in a reading task. The Japanese language was chosen for its simple moraic structure of the Hiragana script as well as for its simple number system so that any measured switch cost would be the result of different cognitive processes running for words and numbers respectively. However, the study revealed that there is little to no switch cost based on different processes alone (§7.1). Even if different processes do take place, switching between them in a language with a simple script and a simple number system is too effortless to assess statistically significant time differences. The study also revealed that numbers were read with less delays than words despite the fact that the symbolic representation of Arabic digits does not give phonetic information (\$7.2). This shows that script-familiarity has a greater effect on reading than the process of transcoding in languages with simple number systems inasmuch as the less familiar Hiragana script caused the Japanese language learners to hesitate more. Furthermore, it was found that lower language proficiency of the participants and higher quantity of syllables within stimuli increased delays (§7.3).

However, there is still a wide range of subjects that were not explored within the scope of this work. It would, for example, also be possible to measure the reading speeds of the stimuli themselves rather than measuring silences between them. If a word and a numeral have the same syllable length, are they also necessarily uttered in the same tempo, or do speakers slow down for either one of them? Further, pronunciation mistakes made by participants were largely ignored in this study. Most importantly, breaks in-between words and in-between numerals were also neglected in the calculations on mean RTs, even though they technically also qualify as processing delays.

Humans are used to interacting with sequences where words and numbers coexist. Even if different cognitive steps do take place, it is therefore convenient that switching between the reading of words and numbers does not cause salient delays. However, more research is necessary to further the understanding of the relationship between linguistic and numerical cognition.

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## Appendix A

In the case that the description of a Figure or a Table is multiple sentences long，only its first sentence is used in the following lists．

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## Appendix B

## I List of all stimuli strings

Glosses are added for understanding．They were created with reference to Ide \＆Yoshida（2017：450）and Shibatani（2018：435－437）．
a．WWWW stimuli type

| \＃ | Stimuli string |  |  |  | Number of syllables |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | ものがたり monogatari ＇story＇ | おんなのひと onna－no－hito woman－GEN－human ＇woman＇ | なつまつり <br> natsu－matsuri summer－festival ＇summer festival＇ | ゆうびんきょくいん yuubinkyoku－in post．office－worker ＇postal worker＇ | 5 |
| 2 | ちかてつ chikatetsu ‘subway’ | はじまり hajimar－i begin－NMLZ ＇beginning＇ | けっこんしき <br> kekkon－shiki <br> marriage－ceremony <br> ＇wedding＇ | むらさき murasaki ＇purple＇ | 4 |
| 3 | いもうとさん imouto－san younger．sister－HON ＇younger sister （of another person）＇ | ちゅうしゃきんし chuusha－kinshi car．parking－ban ＇parking ban＇ | おしらせ <br> $o$－shir－ase <br> HON－know－CAUS <br> ＇notice（information）＇ | にわとり niwatori ‘chicken’ | 4 |
| 4 | ごみばこ gomi－bako trash－box ＇trash can＇ | けいたいでんわ <br> keitai－denwa <br> carry－phone <br> ＇cell phone＇ | あさごはん asa－go－han morning－HON－rice ＇breakfast＇ | てんきよほう tenki－yohou weather－forecast ＇weather forecast＇ | 4 |
| 5 | せつめいしょ setsumei－sho explain－document ＇instruction manual＇ | やさしさ yasashi－sa kind／easy－NMLZ ＇kindness／easiness＇ | えきまえ <br> eki－mae <br> train．station－front <br> ＇front of the train station＇ | ぶたにく buta－niku pig－meat ＇pork＇ | 4 |
| 6 | なまえ <br> namae ＇name＇ | じむしょ jimusho ＇office＇ | れいぞうこ <br> reizouko <br> ＇refrigerator＇ | ちゅらがっこう chuu－gakkou middle－school ＇middle school＇ | 3 |


|  | ひかり | きょうしつ | ばんぐみ | おかね |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 7 | hikari <br> ＇light＇ | kyoushitsu <br> ＇classroom＇ | bangumi ＇programme＇ | o－kane HON－money ＇money＇ | 3 |
|  | しょくどう | せいかつ | れきし | たんじょうび |  |
| 8 | shokudou ＇dining hall＇ | seikatsu <br> ＇life＇ | rekishi <br> ＇history＇ | tanjoubi <br> ‘birthday’ | 3 |
|  | にほんご | みどり | さかな | めがね |  |
| 9 | nihon－go <br> Japan－language <br> ＇Japanese（language）＇ | midori ＇green＇ | sakana <br> ＇fish＇ | megane ＇glasses＇ | 3 |

b．NNNN stimuli type

| $\#$ | Stimuli string |  | Number of <br> syllables |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 86 | 78 | 81 | 67 | 5 |
| 2 | 63 | 21 | 89 | 56 | 4 |
| 3 | 98 | 91 | 62 | 79 | 4 |
| 4 | 73 | 51 | 47 | 91 | 4 |
| 5 | 36 | 53 | 74 | 82 | 4 |
| 6 | 22 | 11 | 29 | 34 | 3 |
| 7 | 54 | 35 | 70 | 25 | 3 |
| 8 | 99 | 94 | 84 | 18 | 3 |
| 9 | 55 |  | 43 | 3 |  |

c．NNNW stimuli type

| \＃ | Stimuli string |  |  |  | Number of syllables |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | 76 | 87 | 61 | じどうはんばいき jidohanbaiki ＇vending machine＇ | 5 |
| 2 | 48 | 31 | 75 | くちびる kuchibiru ＇lips＇ | 4 |
| 3 | 65 | 27 | 84 | びじゅつかん bijutsukan ＇museum＇ | 4 |
| 4 | 37 | 58 | 72 | ```ひきだし hikidashi hik-i-das-i pull-NMLZ-take.out-NMLZ 'drawer'``` | 4 |
| 5 | 38 | 97 | 26 | ```よみかた yom-i-kata read-NMLZ-method 'way of reading'``` | 4 |
| 6 | 33 | 92 | 17 | かぞく <br> kazoku <br> ＇family＇ | 3 |
| 7 | 59 | 44 | 32 | $\begin{aligned} & \text { しゅくだい } \\ & \text { shukudai } \\ & \text { 'homework' } \end{aligned}$ | 3 |
| 8 | 52 | 23 | 49 | はなび hanabi ＇firework＇ | 3 |
| 9 | 45 | 60 | 93 | kokoro ＇heart＇ | 3 |

d．WWWN stimuli type

| \＃ | Stimuli string |  |  |  | Number of syllables |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | ```おくりもの okur-i-mono give.present-NMLZ-thing 'present'``` | まちあわせ machiawase ＇meeting arrangement＇ | ひるやすみ hiru－yasum－i noon－rest－NMLZ ＇lunch break＇ | 71 | 5 |
| 2 | げつようび <br> getsuyoubi <br> ＇Monday＇ | でんわばんごう denwa－bangou phone－number ＇phone number＇ | たてもの <br> tatemono <br> ＇building＇ | 28 | 4 |
| 3 | どうぶつえん <br> doubutsu－en <br> animal－park 'zoo' | かいがいりょこう <br> kaigai－ryokou <br> overseas－travel <br> ＇overseas travel＇ | しあわせ shiawase ＇happiness＇ | 57 | 4 |
| 4 | $\begin{aligned} & \text { ともだち } \\ & \text { tomodachi } \\ & \text { 'friend' } \end{aligned}$ | $\begin{aligned} & \text { うけつけ } \\ & \text { uketsuke } \\ & \text { 'reception (desk)' } \end{aligned}$ | せんたくき sentaku－ki laundry－machine ＇washing machine＇ | 83 | 4 |
| 5 | だいがくせい <br> daigaku－sei <br> university－student <br> ＇university student＇ | のみもの <br> nom－i－mono <br> drink－NMLZ－thing ＇beverage＇ | かみなり <br> kaminari <br> ＇lightning／thunder＇ | 64 | 4 |
| 6 | くるま <br> kuruma ＇car＇ | あたま atama ＇head＇ | うしろ ushiro ＇rear，back＇ | 95 | 3 |
| 7 | ところ <br> tokoro ＇place | ねずみ <br> nezumi ＇mouse／rat＇ | tsukue ＇desk＇ | 42 | 3 |
| 8 | おんがく <br> ongaku <br> ＇music＇ | てがみ tegami ＇letter（mail）＇ | ゆうがた <br> yuugata <br> ＇evening＇ | 16 | 3 |
| 9 | たまご tamago ＇egg＇ | むすめ <br> musume ＇daughter＇ | えんぴつ <br> enpitsu <br> ＇pencil＇ | 39 | 3 |

## II Vocabulary translation task

The following document was handed to each participant in printed form．The task reads Please translate the words you know into German or English．

Universität Regensburg
Sprach－，Literatur－und Kulturwissenschaften Allgemeine und Vergleichende Sprachwissenschaft

## Sprachliche und numerische Kognition im Vergleich

Bitte übersetzen Sie die Ihnen bekannten Wörter auf Deutsch oder Englisch．

| Japanisches Wort | Deutsche／englische Übersetzung |
| :--- | :--- |
| さかな |  |
| めがね |  |
| むらさき |  |
| にわとり |  |
| てんきよほう |  |
| ちゅうがっこう |  |
| おかね |  |
| ぶたにく |  |
| しゅくだい |  |
| おくりもの |  |
| くるま |  |
| ところ |  |
| げつようび |  |
| どうぶつえん |  |
| ともだち |  |
| おんがく |  |
| たまご |  |
| だいがくせい |  |
| まちあわせ |  |
| あたま |  |
| ねずみ |  |
| でんわばんごう |  |
|  |  |


| Japanisches Wort | Deutsche／englische Übersetzung |
| :---: | :---: |
| かいがいりょこう |  |
| うけつけ |  |
| てがみ |  |
| むすめ |  |
| のみもの |  |
| ひるやすみ |  |
| うしろ |  |
| つくえ |  |
| たてもの |  |
| しあわせ |  |
| せんたくき |  |
| ゆうがた |  |
| えんぴつ |  |
| かみなり |  |
| ものがたり |  |
| しょくどう |  |
| にほんご |  |
| ちかてつ |  |
| いもうとさん |  |
| ごみばこ |  |
| なまえ |  |
| ひかり |  |
| せつめいしょ |  |
| おんなのひと |  |
| せいかつ |  |
| みどり |  |
| はじまり |  |
| ちゅうしゃきんし |  |
| けいたいでんわ |  |
| じむしょ |  |
| きょうしつ |  |
| やさしさ |  |
| なつまつり |  |
| れきし |  |


| Japanisches Wort | Deutsche／englische Übersetzung |
| :--- | :--- |
| よみかた |  |
| けっこんしき |  |
| おしらせ |  |
| あさごはん |  |
| れいぞうこ |  |
| ばんぐみ |  |
| えきまえ |  |
| ゆうびんきょくいん |  |
| たんじょうび |  |
| じどうはんばいき |  |
| はなび |  |
| こころ |  |
| くちびる |  |
| びじゅつかん |  |
| ひきだし |  |
| かぞく |  |

## III Collected study data

Delays are given in seconds．
Notation： $\mathrm{SN}=$ serial number， $\mathrm{S}=$ syllable（e．g．， $\mathrm{S} 1=$ first syllable）， $\mathrm{R}=$ error repaired， $\mathrm{NR}=$ error not repaired
Error in reading
The first syllable was repaired（regardless of the participant making an error）．The response time prior to this syllable includes the repair．
a．WWWW stimuli type

| Five syllables |  |  |  | $\begin{gathered} \hline \text { Stimulus } 1 \\ \hline \text { ものがたり } \end{gathered}$mo.no.ga.ta.ri |  |  |  |  |  |  |  |  |  | Stimulus 2おんなのひと on．na．no．hi．to |  |  |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 3 \\ \hline \text { なつまつり } \\ \text { na.tsu.ma.tsu.ri } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  |  |  | Stimulus 4 ゆうびんきょくいん yuu．bin．kyo．ku．in |  |  |  |  |  |  |  |  | Response <br> time |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SN | Pseudonym | Stat | Response | Reading |  |  |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \end{gathered}$ | Reading |  |  |  |  |  |  |  |  | Responsetime | Reading |  |  |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  |  |  |  |  |
|  |  | click | time | s1 | Pause | 52 | Pause | 53 | Pause | 54 | Pause | 55 |  | S1 | Pause | 52 | Pause | 53 | Pause | s4 | Pause | 55 |  | s1 | Pause | 52 | Pause | 53 | Pause | 54 | Pause | 55 |  | s1 | Pause | s2 | Pause | 53 | Pause | 54 | Pause | 55 |  |  |
| A | Subject 1 | $>$ | 1，6427 |  |  |  |  |  |  |  |  |  | 1，2473 |  |  |  | 0，139 |  |  |  |  |  | 0，6096 |  |  |  |  | NR |  |  |  |  | 0，6034 |  |  |  |  |  |  |  | 0，163 |  | 1，2646＜ | ＜ |
| B | Subject 2 | $>$ | 1，9754 |  |  |  |  |  |  |  |  |  | 1，077 |  |  |  |  |  |  |  |  |  | 1，0535 |  |  |  |  |  |  |  |  |  | 1，5452 |  |  |  |  |  |  |  |  |  | 1，2867＜ | ＜ |
| c | Subject 3 | $>$ | 3，3563 |  |  |  | 0，521 |  |  |  |  |  | 0，7777 |  |  |  |  |  | 0，255 |  |  |  | 0，925 |  |  |  |  |  |  |  |  |  | 0，8031 |  |  |  |  |  | 0，338 |  |  |  | 0，5334＜ | ＜ |
| D | Subject 4 | $>$ | 1，7437 |  |  |  |  |  |  |  |  |  | 1，2101 |  |  |  |  |  |  |  |  |  | 1，4574 |  |  |  |  |  |  |  |  |  | 0，56 |  |  |  |  |  |  |  | 0，65 |  |  | $<$ |
| E | Subject 5 | $>$ | 1，6315 |  |  |  |  |  |  |  |  |  | 0，0373 |  |  |  | 0，688 |  |  |  |  |  | 0，0689 |  |  |  |  |  |  |  |  |  | 0，6963 |  |  |  |  |  |  |  |  |  | 0，1916＜ | ＜ |
| F | Subject 6 | $>$ | 2，6363 |  |  |  |  |  |  |  |  |  | 4，7856 | R |  |  |  |  |  |  |  |  | 3，668 |  |  |  |  |  |  |  |  |  | 1，1176 |  |  |  |  |  |  |  |  |  | 0，1058＜ | ＜ |
| 6 | Subject 7 | $>$ | 2，249 |  |  |  |  |  |  |  |  |  | 1，7692 |  |  |  |  |  |  |  |  |  | 4，5879 |  |  |  |  |  |  |  |  |  | 3，8999 |  |  |  |  |  | 0，379 |  |  |  | 0，1039＜ | ＜ |
| H | Subject 8 | $>$ | 1，0923 |  |  |  |  |  |  |  |  |  | 0，8591 |  |  |  |  |  | 0，37 |  |  |  | 0，3429 |  |  |  |  |  | 0，151 |  |  |  | 0，2648 |  |  |  |  |  | 0，455 |  |  |  | 0，0754 $<$ | $<$ |
| 1 | Subject 9 | $>$ | 1，1132 |  |  |  |  |  |  |  |  |  | 0，5254 |  |  |  |  |  |  | NR |  |  | 1，0001 |  |  |  |  |  |  |  |  |  | 0，7139 |  |  |  |  |  |  |  |  |  | 0，8755＜ | ＜ |
| 1 | Subject 10 | $>$ | 1，6318 |  |  |  |  |  |  |  |  |  | 1，1634 | R |  |  |  |  |  |  |  |  | 0，9677 |  |  |  |  |  |  | NR |  |  | 0，5554 |  |  |  |  |  | 0，307 |  |  |  | 0，5358＜ | ＜ |
| k | Subject 11 | $>$ | 2，6664 |  |  |  |  |  | 0，465 | NR |  |  | 0，596 |  |  |  |  |  | 0，329 |  |  |  | 0 |  |  |  |  |  |  |  |  |  | 0，6129 |  |  |  |  |  |  |  |  |  | 0，7473＜ | $<$ |
| L | Subject 12 | $>$ | 1，0701 |  |  |  |  |  |  |  |  |  | 1，1644 |  |  |  |  |  |  |  |  |  | 0，8428 |  |  |  |  |  |  |  |  |  | 1，7047 |  |  |  | 0，541 |  |  |  |  |  | 0，058＜ | ＜ |
| M | Subject 13 | $>$ | 1，2342 |  |  |  |  |  |  |  |  |  | 0，6618 |  |  |  |  |  |  |  |  |  | 0 |  |  |  |  | R | 0，437 |  |  |  | 0，4164 |  |  |  |  |  |  |  | 0，833 |  | 0，7929＜ | ＜ |
| $\cdots$ | Subject 14 | $>$ | 2，0165 |  |  |  |  |  |  |  |  |  | 2，2445 |  |  |  |  |  |  |  |  |  | 1，6609 |  |  |  | 0，754 |  |  |  |  |  | 2，1685 |  |  |  |  | 0，222 |  |  |  |  | 0，4477＜ | ＜ |
| 0 | Subject 15 | $>$ | 1，241 |  |  |  |  |  |  |  |  |  | 0，4583 |  |  |  |  |  |  |  |  |  | 0，4378 |  |  |  |  |  |  |  |  |  | 0，2747 |  |  |  |  |  |  |  |  |  | ＜ | ＜ |
| P | Subject 16 | $>$ | 1，5479 |  |  |  |  |  |  |  |  |  | 0，5482 |  |  |  |  |  |  |  |  |  | 1，5586 |  |  |  |  |  |  |  |  |  | 2，2465 |  |  |  |  |  |  |  |  |  | 0，5179＜ | ＜ |
| Q | Subject 17 | $>$ | 1，1644 |  |  |  |  |  |  |  |  |  | 1，0501 |  |  |  |  |  |  |  |  |  | 0，967 |  |  |  |  |  |  |  |  |  | 0，9358 |  |  |  |  |  |  |  |  |  | 0，8319＜ | ＜ |
| R | Subject 18 | $>$ | 3，554 |  |  |  |  |  |  |  |  |  | 0，9079 |  |  |  |  |  |  |  |  |  | 3，7072 |  |  |  |  |  |  |  |  |  | 3，5886 |  |  |  |  |  |  |  |  |  | 1，3618＜ | ＜ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { ちかてつ } \\ \text { chi.ka.te.tsu } \end{gathered}$ |  |  |  |  |  |  | $\begin{aligned} & \text { Stimulus } 2 \\ & \hline \text { はじまり } \\ & \text { ha.ji.ma.ri } \end{aligned}$ |  |  |  |  |  |  |  |  | Stimulus 3 <br> けっこんしき kek．kon．shi．ki |  |  |  |  |  |  |  | $\begin{aligned} & \text { Stimulus } 4 \\ & \text { むらさき } \\ & \text { mu.ra.sa.ki } \end{aligned}$ |  |  |  |  |  |  | $\begin{gathered} \hline \text { Response } \\ \text { time } \\ \hline \end{gathered}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SN | Pseudonym | Start | Response | Reading |  |  |  |  |  |  | Response $\quad$ Reading |  |  |  |  |  |  |  | Response | Reading |  |  |  |  |  |  | $\begin{array}{\|c\|} \hline \text { Response } \\ \text { time } \\ \hline \end{array}$ | Reading |  |  |  |  |  |  |  |  |
|  |  | click | ime | S1 | Pause | 52 | Pause | 53 | Pause | 54 | time | S1 | Pause | s2 | Pause | 53 | Pause | 54 | time | S1 | Pause | S2 | Pause | 53 | Pause | S4 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |
| A | Subject 1 | $>$ | 1，8917 |  |  |  |  |  |  |  | 0，4060 |  |  |  |  |  |  |  | 0，3956 |  |  |  |  |  |  |  | 0，5514 |  |  |  |  |  |  |  | 0，8132 | $<$ |
| B | Subject 2 | $>$ | 1，6845 |  |  |  |  |  |  |  | 0，8511 |  |  |  |  |  |  |  | 0，9413 |  |  |  |  |  |  |  | 0，5974 |  |  |  |  |  |  |  | 1，0549 | ＜ |
| c | Subject 3 | $>$ | 2，0412 |  |  |  |  |  |  |  | 0，4987 |  |  |  |  |  |  |  | 0，7189 |  |  |  |  |  |  |  | 1，097 |  |  |  | 0，263 |  |  |  | 0，6639 | $<$ |
| D | Subject 4 | $>$ | 3，6298 |  |  |  |  |  |  |  | 2，8408 |  |  |  |  |  |  |  | 0，6645 |  |  |  |  |  |  |  | 0，2096 |  |  |  |  |  |  |  |  | $<$ |
| E | Subject 5 | $>$ | 1，3627 |  |  |  |  |  |  |  | 0，0957 |  |  |  |  |  |  |  | 0，2447 |  |  |  |  |  |  |  | 0，3304 |  |  |  |  |  |  |  | 0，0692 | ＜ |
| F | Subject 6 | $>$ | 2，5461 |  |  |  |  |  |  |  | 1，457 |  |  |  |  |  |  |  | 0，6923 |  |  |  |  |  |  |  | 1，2951 |  |  |  |  |  |  |  | 0，1849 | $<$ |
| G | Subject 7 | $>$ | 1，896 |  |  |  |  |  |  |  | 1，657 |  |  |  |  |  |  |  | 1，0069 |  |  |  |  |  |  |  | 0，8573 |  |  |  |  |  |  |  | 0，319 | $<$ |
| H | Subject 8 | $>$ | 1，0703 |  |  |  |  |  |  |  | 0，4822 |  |  |  |  |  |  |  | 0，2514 |  |  |  |  |  |  |  | 0，3389 |  |  |  |  |  |  |  | 0，1457 | ＜ |
| 1 | Subject 9 | $>$ | 1，0519 |  |  |  |  |  |  |  | 0，5546 |  |  |  |  |  |  |  | 0，4982 |  |  |  |  |  |  |  | 0，5655 |  |  |  |  |  |  |  | 0，6982 | ＜ |
| J | Subject 10 | $>$ | 2，8767 |  |  |  |  |  |  |  | 0，4426 |  |  |  |  |  |  |  | 0，6554 |  |  |  |  |  |  |  | 0，4728 |  |  |  | 0，196 |  |  |  | 0，1428 | $<$ |
| K | Subject 11 | $>$ | 1，8643 |  |  |  |  |  |  |  | 0，1658 |  |  |  |  |  |  |  | 0，394 |  |  |  |  |  |  |  | 0，5253 |  |  |  |  |  |  |  | 1，1556 | ＜ |
| L | Subject 12 | $>$ | 1，4074 |  |  |  |  |  |  |  | 0，6702 |  |  |  |  |  |  |  | 1，0783 |  | 0，302 |  |  |  |  |  | 0，3871 |  |  |  |  |  |  |  | 0，3589 | ＜ |
| M | Subject 13 | $>$ | 1，2717 |  |  |  |  |  |  |  | 0，1259 |  |  |  |  |  |  |  | 0，1739 |  |  |  |  |  |  |  | 0，7298 |  |  |  |  |  |  |  | 0，2856 | $<$ |
| N | Subject 14 | $>$ | 2，1098 |  | 0，197 |  |  |  |  |  | 0，9925 |  |  |  | 0，417 |  |  |  | 1，3394 |  |  |  |  |  |  |  | 1，8439 |  |  |  |  |  |  |  | 0，6843 | ＜ |
| 0 | Subject 15 | $>$ | 1，494 |  |  |  |  |  |  |  | 0，4589 |  |  |  |  |  |  |  | 0，6031 |  |  |  |  |  |  |  | 0，7904 |  |  |  |  |  |  |  | 0，2734 | $<$ |
| P | Subject 16 | $>$ | 1，6692 |  |  |  |  |  |  |  | 0，53 |  |  |  |  |  |  |  | 0，4602 |  |  |  |  |  |  |  | 0，6405 |  |  |  |  |  |  |  | 0，5378 | $<$ |
| Q | Subject 17 | $>$ | 1，1436 |  |  |  |  |  |  |  | 0，3644 |  |  |  |  |  |  |  | 0，5209 |  |  |  |  |  |  |  | 0，78 |  |  |  |  |  |  |  | 0，4579 | ＜ |
| R | Subject 18 | $>$ | 1，4657 |  |  |  |  |  |  |  | 1，0221 |  |  |  |  |  |  |  | 1，5177 |  |  |  |  |  |  |  | 0，7282 |  |  |  |  |  |  |  | 0，1005 | $<$ |


| Four syllables |  |  |  | $\begin{aligned} & \text { Stimulus } 1 \\ & \hline \text { いもうとさん } \\ & \text { i.mou.tou.san } \end{aligned}$ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | timulus |  |  |  | $\begin{aligned} & \text { Stimulus 4 } \\ & \hline \text { にわとり } \\ & \text { ni.wa.to.ri } \end{aligned}$ |  |  |  |  |  |  |  | Response <br> time | （End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  | ちゅうしゃきんし chuu．sha．kin．shi |  |  |  |  |  |  |  | おしらせ o．shi．ra．se |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start | Responsetime |  |  |  |  |  |  |  | Reading |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \\ \hline \end{gathered}$ | Reading |  |  |  |  |  |  | Responsetime | Reading |  |  |  |  |  |  | Response time |  |  | Reading |  |  |  |  |  |  |
| sN |  | click |  | S1 | Pause | S2 | Pause | S3 | Pause | 54 | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | 52 | Pause | 53 | Pause | 54 |  |  |  |
| A | Subject 1 | $>$ | 3，4418 |  |  |  |  |  |  |  | 0，4371 |  | 0，4 |  |  |  |  |  | 0，7592 |  |  |  |  |  |  |  | 0，6761 |  |  |  |  |  |  |  | 0，8839 | ＜ |
| B | Subject 2 | $>$ | 2，6417 |  |  |  |  |  |  |  | 0，957 |  |  |  |  |  |  |  | 1，3312 |  |  |  |  |  |  |  | 0，728 |  |  |  |  |  |  |  | 1，1109 | ＜ |
| c | Subject 3 | $>$ | 4，2877 |  |  |  |  |  |  |  | 2，2734 |  |  |  | 1，05 |  |  |  | 0，8633 |  |  |  |  |  |  |  | 0，6017 |  |  |  |  |  |  |  | 0，2474 | $<$ |
| D | Subject 4 | $>$ | 2，4554 |  |  |  |  |  |  |  | 0，5362 | R | 0，35 |  | 0，362 |  |  |  | 0，1983 |  |  |  |  |  |  |  | 1，2669 |  |  |  |  |  |  |  | －0，6249 | $<$ |
| E | Subject 5 | $>$ | 2，0971 |  |  |  |  |  |  |  | 0，5824 |  |  |  |  |  |  |  | 0，1294 |  |  |  |  |  |  |  | 0，1708 |  |  |  |  |  |  |  | 0，5511 | ＜ |
| F | Subject 6 | $>$ | 4，194 |  |  |  |  |  |  |  | 1，74 |  |  |  |  |  |  |  | 2，0301 |  |  |  |  |  |  |  | 0，6246 |  |  |  |  |  |  |  | 0，2613 | $<$ |
| G | Subject 7 | $>$ | 3，4606 |  |  |  |  |  |  |  | 5，8413 |  |  |  |  |  |  |  | 2，452 |  |  |  |  |  |  |  | 1，1459 |  |  |  |  | NR |  |  | 0 | $<$ |
| H | Subject 8 | $>$ | 1，2417 |  |  |  |  |  |  |  | 1，8253 | R |  |  |  |  |  |  | 0，6719 |  |  |  |  |  |  |  | 0，2243 |  |  |  |  |  |  |  | 0 | $<$ |
| 1 | Subject 9 | $>$ | 1，816 |  |  |  |  |  |  |  | 1，0439 |  |  |  |  |  |  |  | 0，8017 |  |  |  |  |  |  |  | 1，0582 |  |  |  |  |  |  |  | 0，5864 | $<$ |
| J | Subject 10 | $>$ | 1，8427 |  |  |  |  |  |  |  | 1，0515 |  |  |  |  |  |  |  | 2，1134 |  |  |  |  |  |  |  | 0，6873 |  |  |  |  |  |  |  | 0，88 | $<$ |
| K | Subject 11 | $>$ | 2，2903 |  |  |  |  |  |  |  | 0，4229 |  | 0，342 |  | 0，458 |  |  |  | 0，6637 |  |  |  |  |  |  |  | 0，2534 |  |  |  |  |  |  |  | 1，3401 | $<$ |
| L | Subject 12 | $>$ | 1，4449 |  |  |  |  |  |  |  | 0，6352 |  |  |  |  |  |  |  | 1，341 |  |  |  |  |  |  |  | 0，4682 |  |  |  |  |  |  |  | 0，1218 | $<$ |
| M | Subject 13 | $>$ | 1，2342 |  |  |  |  |  |  |  | 0，1422 |  |  |  |  |  |  |  | 0，6034 |  |  |  |  |  |  |  | 0，0632 |  |  |  |  |  |  |  | 0，3305 | $<$ |
| N | Subject 14 | $>$ | 2，3788 |  |  |  |  |  |  |  | 2，8903 |  | 0，533 |  | 1，339 |  |  |  | 3，0739 |  |  |  |  |  |  |  | 1，0683 |  |  |  |  |  |  |  | 0，3266 | ＜ |
| 0 | Subject 15 | $>$ | 3，1847 |  |  |  |  |  |  |  | 1，8562 |  |  |  | 1，329 |  |  |  | 0，6915 |  |  |  |  |  |  |  | 0，3137 |  |  |  |  |  |  |  | 0 | $<$ |
| P | Subject 16 | $>$ | 1，8604 |  |  |  |  |  |  |  | 2，3847 |  | 0，254 |  |  |  |  |  | 2，5877 |  |  |  |  |  |  |  | 0，3899 |  |  |  |  |  |  |  | 0，1254 | $<$ |
| Q | Subject 17 | $>$ | 1，9021 |  |  |  |  |  |  |  | 1，417 |  |  |  |  |  |  |  | 0，6778 |  |  |  |  |  |  |  | 0，7534 |  |  |  |  |  |  |  | 0，3574 | ＜ |
| R | Subject 18 | $>$ | 3，6371 |  |  |  |  |  |  |  | 4，7452 |  |  |  |  |  |  |  | 1，019 |  |  |  |  |  |  |  | 0，7102 |  |  |  |  |  |  |  | 0 | $<$ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { ごみばこ } \end{gathered}$ <br> go．mi．ba．ko |  |  |  |  |  |  |  | Stimulus 2けいたいでんわ kei．tai．den．wa |  |  |  |  |  |  |  | Stimulus 3 <br> a．sa．go．han |  |  |  |  |  |  |  | Stimulus 4てんきよほう ten．ki．yo．hou |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \\ \hline \end{gathered}$ | ｜l｜l｜End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SN | Pseudonym | Start | Response | Reading |  |  |  |  |  |  | Responsetime | Reading |  |  |  |  |  |  | $\begin{array}{\|c\|} \hline \begin{array}{c} \text { Response } \\ \text { time } \end{array} \\ \hline \end{array}$ | Reading |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \\ \hline \end{gathered}$ | Reading |  |  |  |  |  |  |  |  |
|  |  | click | time | S1 | Pause | s2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | 52 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |
| A | Subject 1 | $>$ | 2，2872 |  |  |  |  |  |  |  | 1，1454 |  |  |  |  |  |  |  | 0，9422 |  |  |  |  |  |  |  | 0，3769 | NR |  | NR |  |  |  |  | 1，2267 | ＜ |
| B | Subject 2 | $>$ | 1，8929 |  |  |  |  |  |  |  | 0，98 |  |  |  |  |  |  |  | 1，1014 |  |  |  |  |  |  |  | 1，4102 |  |  |  |  |  |  |  | 0，7271 | ＜ |
| c | Subject 3 | $>$ | 2，2741 |  |  |  |  |  |  |  | 1，5624 |  | 0，536 |  |  |  |  |  | 1，5728 |  |  |  |  |  | 0，1 |  | 0，6735 |  |  |  |  |  | 0，833 |  | 0，3367 | ＜ |
| D | Subject 4 | $>$ | 1，3102 |  |  |  |  |  |  |  | 3，057 |  |  |  |  |  |  |  | 0，6791 |  |  |  |  |  |  |  | 1，2622 |  |  |  |  |  |  |  | 0，0635 | ＜ |
| E | Subject 5 | $>$ | 1，501 |  |  |  |  |  |  |  | 0，5894 |  |  |  |  |  |  |  | 0，0691 |  |  |  |  |  |  |  | 0，3849 |  |  |  |  |  |  |  | 0，3 | ＜ |
| F | Subject 6 | $>$ | 2，8057 |  |  |  |  |  |  |  | 1，3938 |  |  |  |  |  |  |  | 1，9911 |  |  |  |  |  |  |  | 1，9006 |  |  |  |  |  |  |  | 0，1206 | ＜ |
| G | Subject 7 | $>$ | 1，0813 |  |  |  |  |  |  |  | 1，0657 |  |  |  |  |  |  |  | 0，8788 |  |  |  |  |  |  |  | 1，097 |  |  |  |  |  |  |  | 1，0814 | ＜ |
| H | Subject 8 | $>$ | 1，9459 |  |  |  |  |  |  | NR | 0，2 | NR |  |  |  |  |  |  | 0，6966 |  |  |  |  |  |  |  | 0，153 |  |  |  |  |  |  |  | 0，2245 | $<$ |
| 1 | Subject 9 | $>$ | 1，6114 |  |  |  |  |  |  |  | 0，5782 |  |  |  |  |  |  |  | 0，7013 |  |  |  |  |  |  |  | 0，861 |  |  |  |  |  |  |  | 0，0855 | ＜ |
| J | Subject 10 | $>$ | 1，8867 |  |  |  |  |  |  | NR | 0，6578 |  |  |  |  |  |  |  | 1，1317 |  |  |  |  |  |  |  | 0，7592 |  |  |  |  |  |  |  | 0，659 | ＜ |
| K | Subject 11 | $>$ | 1，6168 |  |  |  |  |  |  |  | 0，5784 |  |  |  |  |  |  |  | 0，4268 |  |  |  |  |  |  |  | 1，0487 |  |  |  |  |  |  |  | 1，4428 | ＜ |
| L | Subject 12 | $>$ | 1，537 |  |  |  |  |  |  |  | 0，493 | R |  |  |  |  |  |  | 0，7624 |  |  |  |  |  |  |  | 0，8751 |  |  |  |  |  |  |  | 0，5099 | ＜ |
| M | Subject 13 | $>$ | 1，6174 |  |  |  |  |  |  |  | 0，5287 |  |  |  |  |  |  |  | 0，109 |  |  |  |  |  |  |  | 0，5506 |  |  |  |  |  |  |  | 0，1281 | ＜ |
| N | Subject 14 | $>$ | 1，8296 |  |  |  |  |  |  |  | 1，1012 |  | 0，377 |  |  |  |  |  | 1，2454 |  |  |  |  |  |  |  | 1，1302 |  | 0，634 |  |  |  |  |  | 1，7348 | ＜ |
| 0 | Subject 15 | $>$ | 1，2995 |  |  |  |  |  |  |  | 0，4683 |  |  |  |  |  |  |  | 0，7281 |  |  |  |  |  |  |  | 0，6528 |  |  |  |  |  |  |  | 0 | ＜ |
| P | Subject 16 | $>$ | 2，7156 |  |  |  |  |  |  |  | 1，1701 |  |  |  |  |  |  |  | 0，5304 |  |  |  |  |  |  |  | 2，1302 |  |  |  |  |  |  |  | 0，3556 | ＜ |
| Q | Subject 17 | $>$ | 1，4034 |  |  |  |  |  |  |  | 0，6245 |  |  |  |  |  |  |  | 0，6244 |  |  |  |  |  |  |  | 0，8963 |  |  |  |  |  |  |  | 0，6358 | ＜ |
| R | Subject 18 | $>$ | 1，206 |  |  |  |  |  |  |  | 0，3085 |  |  |  |  |  |  |  | 0，7801 |  |  |  |  |  |  |  | 1，4242 |  |  |  |  |  |  |  | 0，3439 | ＜ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { せつめいしょ } \\ \text { se.tsu.mei.sho } \end{gathered}$ |  |  |  |  |  |  | Stimulus 2 やさしさ ya．sa．shi．sa |  |  |  |  |  |  |  |  | Stimulus 3 えきまえ e．ki．ma．e |  |  |  |  |  |  | Stimulus 4 ぶたにく bu．ta．ni．ku |  |  |  |  |  |  |  | Response <br> time | End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ${ }^{\text {SN }}$ | Pseudonym | Start | Response | Reading |  |  |  |  |  |  | Response | Reading |  |  |  |  |  |  | $\begin{array}{\|c\|} \hline \begin{array}{c} \text { Response } \\ \text { time } \end{array} \\ \hline \end{array}$ | Reading |  |  |  |  |  |  | Responsetime | Reading |  |  |  |  |  |  |  |  |
|  |  | click | time | S1 | Pause | 52 | Pause | 53 | Pause | 54 | time | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |
| A | Subject 1 | $>$ | 1，102 |  |  |  |  |  |  | NR | 0，6521 |  |  |  |  |  | 0，253 |  | 0，593 |  |  |  |  |  |  |  | 1，5813 |  |  |  |  |  |  |  | 0，2621 | ＜ |
| B | Subject 2 | $>$ | 1，1969 |  |  |  |  |  |  |  | 0，7833 |  |  |  |  |  |  |  | 0，8325 |  |  |  |  |  |  |  | 0，7511 |  |  |  |  |  |  |  | 0，873 | ＜ |
| c | Subject 3 | $>$ | 1，787 |  |  |  |  |  |  |  | 0，6403 |  |  |  |  |  | 1，308 |  | 1，479 |  |  |  |  |  |  |  | 1，6785 | R |  |  |  |  |  |  | 0，3946 | ＜ |
| D | Subject 4 | $>$ | 1，4113 |  |  |  |  |  |  |  | 0，3968 |  |  |  |  |  | 1，365 |  | 0，5366 |  |  |  |  |  |  |  | 0，8362 |  |  |  |  |  |  |  | －0，1584 | ＜ |
| E | Subject 5 | $>$ | 1，2645 |  |  |  |  |  |  |  | 0，3882 |  |  |  |  |  |  |  | 0，3763 |  |  |  |  |  |  |  | 0，9644 |  |  |  |  |  |  |  | 0，1606 | ＜ |
| F | Subject 6 | $>$ | 1，6794 |  |  |  |  |  |  |  | 1，4564 |  |  |  |  |  |  |  | 3，7525 |  |  |  |  |  |  |  | 1，015 |  |  |  |  |  |  |  | 0，0723 | ＜ |
| G | Subject 7 | $>$ | 1，8342 |  |  |  |  |  |  |  | 2，8728 |  |  |  |  |  |  |  | 0，8098 |  |  |  |  |  |  |  | 1，7267 |  |  |  |  |  |  |  | 0，1532 | ＜ |
| H | Subject 8 | $>$ | 0，9291 |  |  |  |  |  |  |  | 1，2281 |  |  |  |  |  |  |  | 0，9825 |  |  |  |  |  |  |  | 0，3631 |  |  |  |  |  |  |  | 0 | ＜ |
| 1 | Subject 9 | $>$ | 1，5315 |  |  |  |  |  |  |  | 1，2304 |  |  |  |  |  |  |  | 0，8129 |  |  |  |  |  |  |  | 0，6541 |  |  |  |  |  |  |  | 0，4974 | ＜ |
| J | Subject 10 | $>$ | 2，3987 |  |  |  |  |  |  |  | 2，3045 |  |  |  |  |  |  |  | 1，0873 |  |  |  |  |  |  |  | 0，862 |  |  |  |  |  |  |  | 0，1309 | $<$ |
| K | Subject 11 | $>$ | 1，0943 |  |  |  |  |  |  |  | 0，352 |  |  |  | 0，211 |  |  |  | 0，7775 |  |  |  |  |  |  |  | 0，3359 |  |  |  |  |  |  |  | 1，1971 | ＜ |
| L | Subject 12 | $>$ | 1，0955 |  |  |  |  |  |  |  | 0，6969 |  |  |  |  |  |  |  | 1，2475 |  |  |  |  |  |  |  | 0，8631 |  |  |  |  |  |  |  | 0，2754 | ＜ |
| M | Subject 13 | $>$ | 1，0601 |  |  |  |  |  |  |  | 1，1702 |  |  |  |  |  |  |  | 0，2479 |  |  |  |  |  |  |  | 0，21 |  |  |  |  |  |  |  | －0，0752 | ＜ |
| N | Subject 14 | $>$ | 1，445 |  |  |  |  |  |  |  | 1，516 |  |  |  |  |  |  |  | 1，5482 |  |  |  |  |  |  |  | 1，5482 |  |  |  |  |  |  |  | 0，3467 | ＜ |
| $\bigcirc$ | Subject 15 | $>$ | 1，8647 |  |  |  |  |  |  |  | 1，7262 |  |  |  |  |  | 0，707 |  | 1，5384 |  |  |  |  |  |  |  | 0，9697 |  |  |  |  |  |  |  | 0，2752 | ＜ |
| P | Subject 16 | $>$ | 1，3803 |  |  |  |  |  |  |  | 1，1478 |  |  |  |  |  |  |  | 1，7581 |  |  |  |  |  |  |  | 1，2205 |  |  |  |  |  |  |  | 0，1094 | ＜ |
| Q | Subject 17 | $>$ | 1，6001 |  |  |  |  |  |  |  | 1，2172 |  |  |  |  |  |  |  | 1，4266 |  |  |  |  |  |  |  | 0，4581 |  |  |  |  |  |  |  | 0，6234 | ＜ |
| R | Subject 18 | $>$ | 1，1436 |  |  |  |  |  |  |  | 0，4709 |  |  |  |  |  |  |  | 0，5257 | R |  |  |  |  |  |  | 1，1528 |  |  |  |  |  |  |  | 0 | $<$ |


| Three syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { なまえ } \\ \text { na.ma.e } \\ \hline \end{gathered}$ |  |  |  |  | $\begin{gathered} \text { Stimulus } 2 \\ \hline \text { じむしょ } \\ \text { ji.mu.sho } \\ \hline \end{gathered}$ |  |  |  |  |  | Stimulus 3 れいぞうこ rei．zou．ko |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ \hline \text { ちゅうがっこう } \\ \text { chuu.gak.kou } \\ \hline \end{gathered}$ |  |  |  |  |  | Response time | End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  | Pseudonym | Start click | Response <br> time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S 1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 2，2485 |  |  |  |  |  | 0，2689 |  |  |  |  |  | 0，3124 |  |  | NR |  | NR | 1，0313 |  |  |  |  | NR | 0，4897 | ＜ |
| B | Subject 2 | $>$ | 1，4335 |  |  |  |  |  | 0，9691 |  |  |  |  |  | 0，7874 |  |  |  |  | NR | 1，0799 |  |  |  |  |  | 1，4923 | ＜ |
| C | Subject 3 | $>$ | 1，1168 |  |  |  |  |  | 0，8701 |  |  |  |  |  | 0，3469 |  |  |  |  |  | 2，0603 |  |  |  |  |  | 1，018 | ＜ |
| D | Subject 4 | $>$ | 2，4233 |  |  |  |  |  | 0，5927 |  |  |  |  |  | 1，7006 |  |  |  |  | NR | 2，3667 |  |  | NR |  |  | 0，1535 | ＜ |
| E | Subject 5 | $>$ | 1，49 |  |  |  |  |  | 0 |  |  | NR |  |  | 0，3084 |  |  |  |  |  | 0，5248 |  |  |  |  |  | 0，1415 | ＜ |
| F | Subject 6 | $>$ | 1，6731 |  |  |  |  |  | 1，2948 |  |  |  |  |  | 0，9462 |  |  |  |  |  | 2，2114 |  |  |  |  |  | 0，272 | ＜ |
| G | Subject 7 | $>$ | 1，3805 |  |  |  |  |  | 0，9003 |  |  |  |  |  | 1，4104 |  |  |  |  | NR | 1，3205 |  |  |  |  |  | －0，299 | ＜ |
| H | Subject 8 | $>$ | 0，9683 |  |  |  |  |  | 0，3919 |  |  |  |  |  | 0，5719 |  |  |  |  | NR | 0，8365 | NR |  |  |  |  | 1，3828 | ＜ |
| 1 | Subject 9 | $>$ | 0，9988 |  |  |  |  |  | 0，389 |  |  |  |  |  | 0，6016 |  |  |  |  |  | 0，8049 |  |  |  |  |  | 0，6693 | ＜ |
| J | Subject 10 | $>$ | 1，3545 |  |  |  |  |  | 1，0753 |  |  |  |  |  | 1，592 |  |  |  |  | NR | 1，0055 |  | 0，295 |  |  |  | 0，3524 | ＜ |
| K | Subject 11 | $>$ | 1，5458 |  |  |  |  |  | 0，4874 |  |  | NR |  |  | 1，1178 |  |  |  | 0，353 |  | 1，2834 |  | 0，254 |  |  |  | 0，9153 | ＜ |
| L | Subject 12 | $>$ | 1，5554 |  |  |  |  |  | 0，7305 |  |  |  |  |  | 0，6478 |  |  |  |  |  | 2，3262 |  |  |  |  |  | 0，3975 | ＜ |
| M | Subject 13 | $>$ | 1，207 |  |  |  |  |  | 0，1061 |  |  |  |  |  | 0，2405 |  |  |  |  |  | 0，1577 |  |  |  |  |  | 0 | ＜ |
| N | Subject 14 | $>$ | 1，2163 |  |  |  |  |  | 2，0645 |  |  |  |  |  | 1，2693 |  |  |  |  |  | 2，5166 |  | 0，95 | NR |  | NR | 1，6316 | ＜ |
| 0 | Subject 15 | $>$ | 0，7377 |  |  |  |  |  | 2，6401 |  |  |  |  |  | 2，226 |  |  |  |  |  | 0，2371 |  |  |  |  |  | 0 | ＜ |
| P | Subject 16 | $>$ | 1，5155 |  |  |  |  |  | 0，4245 |  |  |  |  |  | 0，741 |  |  |  |  | R | 1，6974 |  |  |  |  |  | 0 | ＜ |
| Q | Subject 17 | $>$ | 0，9462 |  |  |  |  |  | 0，6761 |  |  |  |  |  | 0，7177 |  |  |  |  |  | 0，7144 |  |  |  |  |  | 0，6147 | ＜ |
| R | Subject 18 | $>$ | 1，1754 |  |  |  |  |  | 0，8227 |  |  |  |  |  | 0，8422 |  |  |  |  |  | 4，4423 |  |  |  |  |  | 1，251 | ＜ |


| Three syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { ひかり } \\ \text { hi.ka.ri } \end{gathered}$ |  |  |  |  | Stimulus 2 <br> きょうしつ <br> kyou．shi．tsu |  |  |  |  |  | $\begin{aligned} & \text { Stimulus } 3 \\ & \hline \text { ばんぐみ } \\ & \text { ban.gu.mi } \\ & \hline \end{aligned}$ |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ \hline \text { おかね } \\ \text { o.ka.ne } \end{gathered}$ |  |  |  |  |  | Response time | $\begin{aligned} & \hline \text { End } \\ & \text { click } \end{aligned}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start <br> click | Response <br> time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S 1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 0，9884 |  |  |  |  |  | 0，3007 |  |  |  |  |  | 0，8935 |  |  |  |  |  | 0，3234 |  |  |  |  |  | 0，95662 | ＜ |
| B | Subject 2 | $>$ | 1，666 |  |  |  |  |  | 0，7501 |  |  |  |  |  | 0，714 |  |  |  |  |  | 0，6127 |  |  |  |  |  | 1，0969 | ＜ |
| c | Subject 3 | $>$ | 1，0459 |  |  |  |  |  | 0，3433 |  |  |  |  |  | 0，5878 |  |  |  |  |  | 0，3552 |  |  |  |  |  | 0，9178 | ＜ |
| D | Subject 4 | $>$ | 1，8503 |  |  |  |  |  | 1，3489 |  |  |  |  |  | 1，1341 |  | 0，358 | R |  |  | 0，3432 |  |  |  |  |  | －0，3829 | ＜ |
| E | Subject 5 | $>$ | 2，0273 |  |  |  |  |  | 0，0708 |  |  |  |  |  | 0，4698 |  |  |  |  |  | 0，0925 |  |  |  |  |  | 0，1911 | $<$ |
| F | Subject 6 | $>$ | 2，4886 |  |  |  |  |  | 0，5817 |  |  |  |  |  | 1，5208 |  |  |  |  |  | 2，143 |  |  |  |  |  | 0，1209 | $<$ |
| G | Subject 7 | $>$ | 1，6357 |  |  |  |  |  | 0，3818 |  |  |  |  |  | 1，406 |  |  |  |  |  | 1，1333 |  |  |  |  |  | 0，187 | ＜ |
| H | Subject 8 | $>$ | 0，9394 |  |  |  |  |  | 0，4245 |  |  |  |  |  | 0，5009 |  |  |  |  |  | 0，5847 |  |  |  |  |  | 0，1564 | ＜ |
| I | Subject 9 | $>$ | 1，0757 |  |  |  |  |  | 0，6372 |  |  |  |  |  | 0，6892 |  |  |  |  |  | 0，6793 |  |  |  |  |  | 0，8981 | ＜ |
| J | Subject 10 | $>$ | 1，1145 |  |  |  |  |  | 0，8032 |  |  |  |  |  | 0，7028 |  |  |  |  |  | 0，6435 |  |  |  |  |  | 0，2425 | ＜ |
| K | Subject 11 | $>$ | 1，1681 |  |  |  |  |  | 0，8796 | NR |  |  |  |  | 0，5795 |  |  |  |  |  | 1，5949 |  |  |  |  |  | 0，4071 | $<$ |
| L | Subject 12 | $>$ | 0，9232 |  |  |  |  |  | 0，3967 |  |  |  |  |  | 0，9774 |  |  |  |  |  | 0，7171 |  |  |  |  |  | 0，1325 | ＜ |
| M | Subject 13 | $>$ | 0，6449 |  |  |  |  |  | 0，0893 |  |  |  |  |  | 0，0895 |  |  |  |  |  | 0，1484 |  |  |  |  |  | 0，3855 | ＜ |
| N | Subject 14 | $>$ | 2，2865 |  |  |  |  |  | 2，2553 |  |  |  |  |  | 3，1696 |  |  |  | 0，607 |  | 1，2579 |  |  |  |  |  | 0，3116 | ＜ |
| 0 | Subject 15 | $>$ | 2，0284 |  |  |  |  |  | 0，179 |  |  |  |  |  | 0，5413 |  |  |  |  |  | 0，3956 |  |  |  |  |  | 0，1644 | ＜ |
| P | Subject 16 | $>$ | 1，1206 |  |  |  |  |  | 0，3744 |  |  |  |  |  | 0，5773 |  |  |  |  |  | 0，3578 |  |  |  |  |  | 0，1485 | ＜ |
| Q | Subject 17 | $>$ | 1，1021 |  |  |  |  |  | 0，6098 |  |  |  |  |  | 0，9462 |  |  |  |  |  | 0，9193 |  |  |  |  |  | 0，4181 | ＜ |
| R | Subject 18 | $>$ | 1，393 |  |  |  |  |  | 1，5696 |  |  | R |  |  | 1，4865 |  |  |  |  |  | 0，6039 |  |  |  |  |  | 0，3543 | ＜ |


| Three syllables |  |  |  | $\begin{aligned} & \text { Stimulus } 1 \\ & \hline \text { しょくどう } \\ & \text { sho.ku.dou } \end{aligned}$ |  |  |  |  | $\begin{gathered} \text { Stimulus } 2 \\ \hline \text { せいかつ } \\ \text { sei.ka.tsu } \end{gathered}$ |  |  |  |  |  | $\begin{aligned} & \frac{\text { Stimulus } 3}{} \\ & \hline \text { れきし } \\ & \text { re.ki.shi } \end{aligned}$ |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ \hline \text { たんじょうび } \\ \text { tan.jou.bi } \end{gathered}$ |  |  |  |  |  | Response time | Endclick |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SN | Pseudonym | Start <br> click | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Responsetime | Reading |  |  |  |  | Response time | Reading |  |  |  |  |  |  |
|  |  |  |  | S 1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 1，7981 |  |  |  |  |  | 0，3851 |  |  |  |  |  | 0，3127 |  |  |  |  |  | 0，3444 |  |  |  |  |  | 0，7592 | ＜ |
| B | Subject 2 | $>$ | 1，1722 |  |  |  |  |  | 0，5458 |  |  |  |  |  | 0，6471 |  |  |  |  |  | 0，7409 |  |  |  |  |  | 0，4037 | ＜ |
| C | Subject 3 | $>$ | 1，8021 |  |  |  |  |  | 0，6791 |  |  |  |  |  | 0，8655 |  |  |  |  |  | 0，7347 |  | 0，33 |  |  |  | 0，2201 | ＜ |
| D | Subject 4 | $>$ | 2，845 |  |  |  |  |  | 0，2325 |  |  |  |  |  | 0，2181 |  |  |  |  |  | 0，4869 |  |  |  |  |  | 0，06 | ＜ |
| E | Subject 5 | $>$ | 1，2915 |  |  |  |  |  | 0 |  |  |  |  |  | 0，6961 |  |  |  |  |  | 0，0889 |  |  |  |  |  | 0 | ＜ |
| F | Subject 6 | $>$ | 2，8074 |  |  |  |  |  | 1，3101 |  |  |  |  |  | 1，7421 |  |  |  |  |  | 4，4055 |  |  |  |  |  | 0，5588 | ＜ |
| G | Subject 7 | $>$ | 2，9423 |  |  |  |  |  | 0，3443 |  |  |  |  |  | 2，476 |  |  |  |  |  | 0，888 |  |  |  |  |  | －0，303 | ＜ |
| H | Subject 8 | $>$ | 1，0866 |  |  |  |  |  | 0，1619 |  |  |  |  |  | 1，0178 |  |  |  |  |  | 0，6543 |  |  |  |  |  | －0，2139 | ＜ |
| 1 | Subject 9 | $>$ | 1，1677 |  |  |  |  |  | 0，5729 |  |  |  |  |  | 0，7442 |  |  |  |  |  | 0，6187 |  |  |  |  |  | 0，8128 | ＜ |
| J | Subject 10 | $>$ | 1，5039 |  |  |  |  |  | 0，6514 |  |  |  |  |  | 0，6871 |  |  |  |  |  | 0，8878 |  |  |  |  |  | 0，2072 | ＜ |
| K | Subject 11 | $>$ | 1，2938 |  |  |  |  |  | 0，314 |  |  |  |  |  | 0，5471 |  |  |  |  |  | 0，5745 |  |  |  |  |  | 1，0737 | ＜ |
| L | Subject 12 | $>$ | 2，2761 |  |  |  |  |  | 0，4799 |  |  |  |  |  | 0，4164 |  |  |  |  |  | 0，6553 |  | 0，169 |  |  |  | 0，1802 | ＜ |
| M | Subject 13 | $>$ | 1，0544 |  |  |  |  |  | 0，1632 |  |  |  |  |  | 0，0179 |  |  |  |  |  | 0，4384 |  |  |  |  |  | 0，1059 | ＜ |
| N | Subject 14 | $>$ | 2，3281 |  |  |  |  |  | 2，0396 |  |  |  |  |  | 1，0382 |  |  |  |  |  | 1，0739 |  |  |  |  |  | 0，6249 | ＜ |
| 0 | Subject 15 | $>$ | 1，1096 |  |  |  |  |  | 0，288 |  |  |  |  |  | 0，3208 |  |  |  |  |  | 0，3965 |  |  |  |  |  | 0，1568 | ＜ |
| P | Subject 16 | $>$ | 1，4101 |  |  |  |  |  | 0，6422 |  |  |  |  |  | 0，4074 |  |  |  |  |  | 0，3623 |  |  |  |  |  | 0，4144 | ＜ |
| Q | Subject 17 | $>$ | 1，4969 | NR |  |  |  |  | 0，5469 |  |  |  |  |  | 0，7706 |  |  |  |  |  | 0，6531 |  |  |  |  |  | 0，5783 | ＜ |
| R | Subject 18 | $>$ | 1，58 |  |  |  |  |  | 0，3216 |  |  |  |  |  | 1，1223 |  |  |  |  |  | 0，2687 |  |  |  |  |  | 0 | ＜ |



## b. NNNN stimuli type

| Five syllables |  |  |  | $\frac{\text { Stimulus } 1}{86}$ |  |  |  |  |  |  |  |  |  | Stimulus 278 |  |  |  |  |  |  |  |  |  | Stimulus 381ha.chi.juu.i.chi |  |  |  |  |  |  |  |  |  | Stimulus 467ro.ku.juu.na.na |  |  |  |  |  |  |  |  | Response <br> time $\begin{aligned} & \text { End } \\ & \text { cick } \\ & \text { cick }\end{aligned}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| ${ }_{\text {SN }}$ | Pseudonym | Start | Response |  |  |  |  |  |  |  |  |  | Reading |  |  |  |  |  |  |  |  | Response time | Reading |  |  |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \end{gathered}$ | Reading |  |  |  |  |  |  |  |  | Response |  |  | Reding |  |  |  |  |  |  |  |  |
|  |  | click | time | s1 | Pause | 52 | Pause | s3 | Pause | 54 | Pause | 55 | s1 | Pause | s2 | Pause | 53 | Pause | s4 | Pause | 55 |  | s1 | Pause | 52 | Pause | 53 | Pause | 54 | Pause | 55 |  | S1 | Pause | 52 | Pause | 53 | Pause | 54 | Pause | 55 |  |  |  |
| A | subject 1 | $>$ | 4,4607 |  |  |  |  |  |  |  |  |  | 0,5722 |  |  |  |  |  |  |  |  |  | 0,3176 |  |  |  | 0,158 |  | 0,29 |  |  |  | 0,3124 |  |  |  |  |  | 0,728 |  |  |  | 0,4070 < | < |
| B | subject 2 | $>$ | 0,7231 |  |  |  |  |  |  |  |  |  | 0,5959 |  |  |  |  |  |  |  |  |  | 0,8854 |  |  |  |  |  |  |  |  |  | 0,9889 |  |  |  |  |  |  |  |  |  | 1,1239 < | < |
| c | Subject 3 | $>$ | 2,2594 |  |  |  | 0,924 |  |  |  |  |  | 0,1834 |  |  |  |  |  | 2,339 |  |  |  | 0,5042 |  |  |  |  |  |  |  |  |  | 0,948 |  |  |  | 0,318 |  | 0,409 |  |  |  | 0,4598 < | < |
| D | Subject 4 | $>$ | 8,0187 |  |  |  |  |  |  |  |  |  | 0,6482 |  |  |  |  |  | 1,605 |  |  |  | 1,4686 |  |  |  |  |  |  |  |  |  | 1,4127 |  |  |  |  |  | 0,734 |  |  |  | -0,4036 < | < |
| E | Subject 5 | $>$ | 1,3909 |  |  |  |  |  |  |  |  |  | 0,1443 |  |  |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  |  |  | 0,1932 |  |  |  |  |  |  |  |  |  | 0,4466 < | $<$ |
| F | subject 6 | $>$ | 1,5259 |  |  |  |  |  |  |  |  |  | 0,5291 |  |  |  |  |  |  |  |  |  | 0,665 |  |  |  |  |  |  |  |  |  | 0,5053 |  |  |  |  |  |  |  |  |  | 0,493 < | $<$ |
| 6 | Subject 7 | $>$ | 1,6711 |  |  |  |  |  |  |  |  |  | 5,3464 |  |  |  |  |  |  |  |  |  | 2,4917 |  |  |  |  |  |  |  |  |  | 0,89 |  |  |  |  |  | 0,425 |  |  |  | 0,0734 < | < |
| H | Subject 8 | $>$ | 2,3429 |  |  |  |  |  |  |  |  |  | 0,1632 |  |  |  |  |  |  |  |  |  | 0,4756 |  |  |  |  |  |  |  |  |  | 0,4503 |  |  |  |  |  |  |  |  |  |  | < |
| 1 | Subject 9 | $>$ | 1,2459 |  |  |  |  |  |  |  |  |  | 0,4323 |  |  |  |  |  |  |  |  |  | 0,5741 |  |  |  |  |  |  |  |  |  | 0,4611 |  |  |  |  |  |  |  |  |  | 0,7908 < | < |
| , | Sujject 10 | $>$ | 2,5678 |  |  |  |  |  |  |  |  |  | 0,6355 |  |  |  |  |  |  |  |  |  | 0,8084 |  |  |  |  |  | 0,231 |  |  |  | 0,8709 |  |  |  |  |  | 1,712 |  |  |  |  | $<$ |
| k | Subject 11 | $>$ | 1,0363 |  |  |  |  |  |  |  |  |  | 0,4909 |  |  |  |  |  |  |  |  |  | 0,5025 |  |  |  |  |  |  |  |  |  | 0,7312 |  |  |  |  |  |  |  |  |  | 0,8073 < | < |
| L | Sujject 12 | $>$ | 1,2377 |  |  |  |  |  |  |  |  |  | 1,5282 |  |  |  |  |  |  |  |  |  | 0,8269 |  |  |  |  |  |  |  |  |  | 0,6335 |  |  |  |  |  |  |  |  |  |  | < |
| M | Sujject 13 | $>$ | 0,9878 |  |  |  |  |  |  |  |  |  | 0,2609 |  |  |  |  |  |  |  |  |  | 0,1363 |  |  |  |  |  |  |  |  |  | 0,1222 |  |  |  |  |  | 0,267 |  |  |  | 0,3502 < | < |
| $\cdots$ | Subject 14 | $>$ | 3,1882 |  | 0,199 |  |  |  |  |  |  |  | 2,0488 |  |  |  |  |  |  |  |  |  | 1,0403 |  |  |  |  |  | 0,262 |  |  |  | 0,6082 |  |  |  |  |  | 0,446 |  |  |  | 0,2077 < | < |
| 0 | Subject 15 | $>$ | 1,6001 |  |  |  |  |  | 0,286 |  |  |  | 1,4341 |  |  |  |  |  | 1,435 |  |  |  | 0,187 |  |  |  |  |  |  |  |  |  | 0,4279 |  |  |  |  |  | 1,564 |  |  |  | -0,7089 < | < |
| P | Subject 16 | $>$ | 1,4977 |  |  |  |  |  |  |  |  |  | 1,7216 |  |  |  |  |  |  |  |  |  | 1,9876 |  |  |  |  |  |  |  |  |  | 0,3919 |  |  |  |  |  |  |  |  |  | 0,1939 < | $<$ |
| a | Subject 17 | $>$ | 1,0709 |  |  |  |  |  |  |  |  |  | 0,5203 |  |  |  |  |  |  |  |  |  | 0,4279 |  |  |  |  |  |  |  |  |  | 0,5414 |  |  |  |  |  |  |  |  |  | 0,2791 < | $<$ |
| R | Subject 18 | $>$ | 0,8717 |  |  |  |  |  |  |  |  |  | 0,142 |  |  |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  |  |  | 0,0516 |  |  |  |  |  |  |  |  |  | 0,4755 < | $<$ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ 63 \\ \text { ro.ku.juu.san } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  | $\begin{gathered} \frac{\text { Stimulus } 2}{21} \\ \text { ni.juu.i.chi } \\ \hline \end{gathered}$ |  |  |  |  |  |  | Stimulus 389ha.chi.juu.kyuu |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ 56 \\ \text { go.juu.ro.ku } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  | Response time | (End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Startclick | Response <br> time |  |  |  |  |  |  |  | Reading |  |  |  |  |  |  | Responsetime | Reading |  |  |  |  |  |  | Response time | Reading |  |  |  |  |  |  | Response time |  |  | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | 52 | Pause | S3 | Pause | 54 | s1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |  |
| A | Subject 1 | $>$ | 7,0227 |  |  |  |  |  |  |  | 0,4579 |  |  |  |  |  |  |  | 9,5358 |  |  |  | 0,936 |  | 0,306 |  | 0,6329 |  |  |  |  |  |  |  | 0,6573 | $<$ |
| B | Subject 2 | $>$ | 1,5271 |  |  |  |  |  |  |  | 0,459 |  |  |  |  |  |  |  | 0,612 |  |  |  |  |  |  |  | 0,647 |  |  |  |  |  |  |  | 0,4469 | < |
| c | Subject 3 | $>$ | 1,389 |  |  |  | 0,21 |  | 0,328 |  | 0,8444 |  |  |  |  |  | 0,22 |  | 0,7769 |  |  |  |  |  |  |  | 0,5991 |  |  |  |  |  |  |  | 0,1526 | $<$ |
| D | Subject 4 | $>$ | 1,1335 |  |  |  |  |  |  |  | 0,3108 |  |  |  |  |  |  |  | 0,7852 |  |  |  |  |  | 0,219 |  | 1,1751 |  |  |  | 0,282 |  |  |  | -0,2719 | < |
| E | Subject 5 | $>$ | 1,5332 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 0,0555 |  |  |  |  |  |  |  | 0,2986 |  |  |  |  |  |  |  | 0,4935 | < |
| F | Subject 6 | $>$ | 2,7137 |  |  |  |  |  |  |  | 1,1731 |  |  |  |  |  |  |  | 2,5441 |  |  |  |  |  |  |  | 0,7977 |  |  |  |  |  |  |  | 0,2723 | $<$ |
| G | Subject 7 | $>$ | 1,8653 |  |  |  |  |  |  |  | 0,9695 |  |  |  |  |  |  |  | 0,7493 |  |  |  |  |  |  |  | 2,528 |  |  |  |  |  |  |  |  | $<$ |
| H | Subject 8 | $>$ | 1,1208 |  |  |  |  |  |  |  | 0,2663 |  |  |  |  |  | 0,358 |  | 1,0046 |  |  |  |  |  |  |  | 0,508 |  |  |  |  |  |  |  | -0,1902 | $<$ |
| 1 | Subject 9 | $>$ | 1,3629 |  |  |  |  |  |  |  | 0,2971 |  |  |  |  |  |  |  | 0,6013 |  |  |  |  |  |  |  | 0,6931 |  |  |  |  | R | 0,169 |  | 0,5777 | $<$ |
| J | Subject 10 | $>$ | 1,6545 |  |  |  |  |  |  |  | 0,7588 |  | 0,19 |  |  |  |  |  | 1,4101 |  |  |  |  |  | 0,19 |  | 1,3302 |  |  |  |  |  |  |  | 0,2002 | $<$ |
| K | Subject 11 | $>$ | 2,0001 |  |  |  |  |  | 0,338 |  | 0,5416 |  |  |  |  |  |  |  | 0,3032 |  |  |  |  |  |  |  | 0,5349 |  |  |  |  |  |  |  |  | $<$ |
| L | Subject 12 | $>$ | 1,58 |  |  |  |  |  |  |  | 0,354 |  |  |  |  |  |  |  | 0,6138 |  |  |  |  |  |  |  | 1,1095 |  |  |  |  |  |  |  | 0,3166 | < |
| M | Subject 13 | $>$ | 1,1501 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 0,0533 |  |  |  |  |  |  |  | 0,5631 |  |  |  |  | NR |  |  | 0,0555 | $<$ |
| N | Subject 14 | $>$ | 1,2607 |  |  |  |  |  |  |  | 0,998 |  |  |  |  |  |  |  | 0,7492 |  |  |  |  |  |  |  | 1,0769 |  |  |  |  |  |  |  | 0,2036 | < |
| 0 | Subject 15 | $>$ | 1,2164 |  |  |  |  |  |  |  | 0,2428 |  |  |  |  |  |  |  | 0,6028 |  |  |  |  |  |  |  | 0,4706 |  |  |  |  |  |  |  | -0,2064 | $<$ |
| P | Subject 16 | $>$ | 1,2415 |  |  |  |  |  |  |  | 0,1543 |  |  |  |  |  |  |  | 0,2251 |  |  |  |  |  |  |  | 0,504 |  |  |  |  |  |  |  |  | $<$ |
| Q | Subject 17 | $>$ | 1,3722 |  |  |  |  |  |  |  | 0,4577 |  |  |  |  |  |  |  | 0,8143 |  |  |  |  |  |  |  | 0,7001 |  |  |  |  |  |  |  | 0,2161 | < |
| R | Subject 18 | $>$ | 1,0917 |  |  |  |  |  |  |  | 0,074 |  |  |  |  |  |  |  | 0,2804 |  |  |  |  |  |  |  | 0,2482 |  |  |  |  |  |  |  | 0,163 | $<$ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ 98 \\ \text { kyuu.juu.ha.chi } \end{gathered}$ |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 2 \\ 41 \\ \text { yon.juu.i.chi } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 3 \\ \hline 62 \\ \text { ro.ku.juu.ni } \\ \hline \end{gathered}$ |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ 79 \\ \text { na.na.juu.kyu } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \\ \hline \end{gathered}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start | $\begin{gathered} \hline \text { Response } \\ \text { time } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  | Reading |  |  |  |  |  |  | Response time | Reading |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \end{gathered}$ | Reading |  |  |  |  |  |  | Response <br> time |  |  | Reading |  |  |  |  |  |  |
|  |  | click |  | S1 | Pause | 52 | Pause | 53 | Pause | 54 | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | 52 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |  |
| A | Subject 1 | $>$ | 1,8719 |  |  |  |  |  |  |  | 0,235 |  |  |  |  |  |  |  | 0,242 |  |  |  |  |  |  |  | 1,0144 |  |  |  |  |  |  |  | 0,2689 | < |
| B | Subject 2 | $>$ | 1,4181 |  | 0,227 |  |  |  |  |  | 0,6255 |  |  |  |  |  |  |  | 0,3966 |  |  |  |  |  |  |  | 0,6351 |  |  |  |  |  |  |  | 0,3843 | < |
| c | Subject 3 | $>$ | 3,2249 |  |  |  | 0,543 |  |  |  | 1,3608 |  |  |  |  |  |  |  | 0,4311 |  |  |  |  |  | 0,956 |  | 0,6372 |  |  |  |  |  |  | NR | 0,6677 | < |
| D | Subject 4 | $>$ | 1,392 |  |  |  |  |  |  |  | 1,5583 |  |  |  |  |  |  |  | 0,2784 |  |  |  |  |  |  |  | 0,4462 |  |  |  | 1,131 |  |  |  | 0,0431 | $<$ |
| E | Subject 5 | $>$ | 1,1592 |  |  |  |  |  |  |  | 0,1961 |  |  |  |  |  |  |  | 0,1366 |  |  |  |  | R | 0,35 |  | 0,1793 |  |  |  |  |  |  |  | 0,2413 | < |
| F | Subject 6 | $>$ | 1,2907 |  |  |  |  |  |  |  | 0,2653 |  |  |  |  |  |  |  | 0,4193 |  |  |  |  |  |  |  | 1,0169 |  |  |  |  |  |  |  | 0,0638 | < |
| G | Subject 7 | $>$ | 8,0138 |  |  |  |  |  |  |  | 1,5439 |  |  |  | 0,637 |  |  |  | 3,3884 |  |  |  |  |  |  |  | 2,0213 |  |  |  |  |  | 0,601 |  | 0,4534 | < |
| H | Subject 8 | $>$ | 1,0625 |  |  |  |  |  |  |  | 1,3166 |  |  |  |  |  |  |  | 0,7515 |  |  |  |  |  |  |  | 0,2656 |  |  |  |  |  | 0,186 |  | 0 | < |
| 1 | Subject 9 | $>$ | 1,1607 |  |  |  |  |  |  |  | 0,2302 |  |  |  |  |  |  |  | 0,4455 |  |  |  |  |  |  |  | 0,6418 |  |  |  |  |  |  | R | 0,9924 | < |
| J | Subject 10 | $>$ | 1,239 |  |  |  |  |  |  |  | 3,1454 |  |  |  |  |  |  |  | 1,634 |  |  |  |  |  |  |  | 0,6965 |  |  |  |  |  |  |  | -0,2183 | < |
| K | Subject 11 | $>$ | 0,947 |  |  |  |  |  |  |  | 0,1591 |  |  |  |  |  |  |  | 0,8016 |  |  |  |  |  |  |  | 0,4584 |  |  |  |  |  | 0,29 |  | 0,3658 | < |
| L | Subject 12 | $>$ | 0,967 |  |  |  |  |  |  |  | 0,5938 |  |  |  |  |  |  |  | 0,7284 |  |  |  |  |  |  |  | 1,2083 |  |  |  |  |  |  |  | 0 | $<$ |
| M | Subject 13 | $>$ | 1,3677 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 0,4971 |  |  |  |  |  |  |  | 0,554 | < |
| N | Subject 14 | $>$ | 1,2071 |  |  |  |  |  |  |  | 1,3673 |  |  |  |  |  |  |  | 0,5302 |  |  |  |  |  |  |  | 0,6907 |  |  |  |  |  |  | NR | 0,2986 | < |
| 0 | Subject 15 | $>$ | 1,2371 |  |  |  |  |  |  |  | 0,4651 |  |  |  |  |  |  |  | 0,4503 |  |  |  |  |  |  |  | 2,1274 |  |  |  |  |  | 0,479 |  | 0,5287 | < |
| P | Subject 16 | $>$ | 1,4576 |  |  |  |  |  |  |  | 0,7483 |  |  |  |  |  |  |  | 0,2166 |  |  |  |  |  |  |  | 2,2974 |  |  |  |  |  |  |  | 0,2399 | < |
| Q | Subject 17 | $>$ | 1,1021 |  |  |  |  |  |  |  | 0,4868 |  |  |  |  |  |  |  | 1,05 |  |  |  |  |  |  |  | 0,7527 |  |  |  |  |  |  |  | 0,9965 | < |
| R | Subject 18 | $>$ | 1,341 |  |  |  |  |  |  |  | 0,3644 |  |  |  |  |  |  |  | 0,1905 |  |  |  |  |  |  |  | 0,3961 |  |  |  |  |  |  |  | 0,24 | < |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline 73 \\ \text { na.na.juu.san } \end{gathered}$ |  |  |  |  |  |  | Stimulus 296kyuu.juu.ro.ku |  |  |  |  |  |  |  | Stimulus 347yon.juu.na.na |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ 91 \\ \text { kyuu.juu.i.chi } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  | Response time | End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Startclick | Response time | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  | Responsetime | Reading |  |  |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | 52 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |
| A | Subject 1 | $>$ | 1,3932 |  |  |  |  |  |  |  | 0,3332 |  |  |  |  |  |  |  | 1,0811 |  |  |  |  |  |  |  | 0,4062 |  |  |  |  |  |  |  | 0,3504 | $<$ |
| B | Subject 2 | $>$ | 1,9302 |  |  |  |  |  |  |  | 0,6198 |  |  |  |  |  |  |  | 0,708 |  |  |  |  |  |  |  | 0,4787 |  |  |  |  |  |  |  | 0,5768 | $<$ |
| c | Subject 3 | $>$ | 1,1033 |  |  |  |  |  |  |  | 0,587 |  |  |  |  |  |  |  | 0,4454 |  |  |  |  |  |  |  | 0,4179 |  |  |  |  |  |  |  | 0,105 | $<$ |
| D | Subject 4 | $>$ | 1,6266 |  |  |  |  |  |  |  | 0,5351 |  |  |  | 0,537 |  |  |  | 0,4545 |  |  |  |  |  |  |  | 0,5348 |  |  |  |  |  |  |  | -0,1683 | $<$ |
| E | Subject 5 | $>$ | 1,0398 |  |  |  |  |  |  |  | 0,0742 |  |  |  |  |  |  |  | 1,2344 |  |  |  |  |  |  |  | 0,1725 |  |  |  |  |  |  |  | 0,5193 | < |
| F | Subject 6 | $>$ | 4,384 |  |  |  |  |  | 0,294 |  | 0,6631 |  |  |  |  |  |  |  | 2,0762 |  |  |  | 0,234 |  |  |  | 0,4077 |  |  |  |  |  |  |  | 0,353 | $<$ |
| G | Subject 7 | $>$ | 3,5739 |  |  |  |  |  |  |  | 0,9585 |  |  |  |  |  |  |  | 1,5189 |  |  |  | 0,538 |  |  |  | 1,168 |  |  |  | 0,201 |  |  |  | 0,1141 | $<$ |
| H | Subject 8 | $>$ | 1,1682 |  |  |  |  |  |  |  | 0,231 |  |  |  |  |  |  |  | 0,4698 |  |  |  |  |  |  |  | 0,7304 |  |  |  |  |  |  |  | 0,0564 | < |
| 1 | Subject 9 | $>$ | 1,1245 |  |  |  |  |  |  |  | 0,4924 |  |  |  |  |  |  |  | 0,4802 |  |  |  |  |  |  |  | 0,5272 |  |  |  |  |  |  |  | 0,5041 | $<$ |
| J | Subject 10 | $>$ | 2,0094 |  |  |  |  |  |  |  | 2,04 |  |  |  | 0,182 |  |  |  | 3,7078 |  |  |  |  |  |  |  | 1,3733 |  |  |  |  |  |  |  | 0,7127 | $<$ |
| K | Subject 11 | $>$ | 1,1902 |  |  |  |  |  |  |  | 0,1077 |  |  |  |  |  |  |  | 1,1103 |  |  |  |  |  |  |  | 0,2882 |  |  |  |  |  |  |  | 0,2178 | $<$ |
| L | Subject 12 | $>$ | 1,7255 |  |  |  |  |  |  |  | 0,6444 |  |  |  |  |  |  |  | 0,9671 |  |  |  |  |  |  |  | 0,4787 |  |  |  |  |  |  |  | 0,0987 | $<$ |
| M | Subject 13 | $>$ | 1,0475 |  |  |  |  |  |  |  | 0,5008 |  |  |  |  |  |  |  | 0,1754 |  |  |  |  |  |  |  | 0,0754 |  |  |  |  |  |  |  | 0,2562 | $<$ |
| N | Subject 14 | $>$ | 2,0891 |  |  |  |  |  |  |  | 0,7421 |  |  |  |  |  |  |  | 0,7129 |  |  |  |  |  |  |  | 0,8947 |  |  |  |  |  |  |  | 0,6674 | < |
| 0 | Subject 15 | $>$ | 2,448 |  |  |  |  |  | 0,217 |  | 2,0678 |  |  |  |  |  |  |  | 0,189 |  |  |  | 0,49 |  |  |  | 0,3953 |  |  |  | 0,468 |  |  |  | 0,2737 | $<$ |
| P | Subject 16 | $>$ | 1,911 |  |  |  |  |  |  |  | 0,441 |  |  |  |  |  |  |  | 0,4237 |  |  |  |  |  |  |  | 0,5286 |  |  |  |  |  |  |  | 0,0782 | $<$ |
| Q | Subject 17 | $>$ | 1,0086 |  |  |  |  |  |  |  | 0,5933 |  |  |  |  |  |  |  | 0,6061 |  |  |  |  |  |  |  | 0,6418 |  |  |  |  |  |  |  | 0,4785 | < |
| R | Subject 18 | $>$ | 0,967 |  |  |  |  |  |  |  | 0,2195 |  |  |  |  |  |  |  | 0,3644 |  |  |  |  |  |  |  | 0,3861 |  |  |  |  |  |  |  | 0,3246 | $<$ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ 36 \\ \text { san.juu.ro.ku } \\ \hline \end{gathered}$ |  |  |  |  |  |  | $\begin{gathered} \frac{\text { Stimulus } 2}{51} \\ \text { go.juu.i.chi } \end{gathered}$ |  |  |  |  |  |  |  |  | Stimulus 374na.na.juu.yon |  |  |  |  |  |  | Stimulus 482ha.chi.juu.ni |  |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \\ \hline \end{gathered}$ |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start | $\begin{gathered} \text { Response } \\ \text { time } \end{gathered}$ |  |  |  |  |  |  |  | Reading |  |  |  |  |  |  | Response time | Reading |  |  |  |  |  |  | $\begin{array}{\|c\|} \hline \text { Response } \\ \text { time } \\ \hline \end{array}$ | Reading |  |  |  |  |  |  | Response time |  |  | Reading |  |  |  |  |  |  |
|  |  | did |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |  |
| A | Subject 1 | $>$ | 1,3587 |  |  |  |  |  |  |  | 0,4374 |  |  |  | 0,249 |  |  |  | 0,7077 |  |  |  |  |  |  |  | 6,9507 |  | 0,224 |  |  |  | 0,239 |  | 0,3636 | < |
| B | Subject 2 | $>$ | 1,3778 |  |  |  |  |  |  |  | 0,6138 |  |  |  |  |  |  |  | 0,9353 |  |  |  |  |  |  |  | 0,6469 |  |  |  |  |  |  |  | 0,8872 | $<$ |
| c | Subject 3 | $>$ | 1,0222 |  |  |  |  |  |  |  | 0,4038 |  |  |  |  |  |  |  | 1,8488 |  |  |  |  |  |  |  | 0,334 |  |  |  |  |  |  |  | 0,3641 | < |
| D | Subject 4 | $>$ | 1,0501 |  |  |  |  |  |  |  | 0,8067 |  |  |  |  |  |  |  | 0,414 |  |  |  | 0,243 |  | 0,323 |  | 0,5302 |  |  |  |  |  |  |  | -0,2333 | < |
| E | Subject 5 | $>$ | 1,1174 |  |  |  |  |  |  |  | 0,0753 |  |  |  |  |  |  |  | 0,7144 |  |  |  |  |  |  |  | 0,1213 |  | 0,22 |  |  |  | 0,325 |  | 0,2659 | < |
| F | Subject 6 | $>$ | 1,9285 |  |  |  |  |  |  |  | 0,497 |  |  |  |  |  |  |  | 1,6021 |  |  |  |  |  |  |  | 0,4561 |  |  |  |  |  |  |  | 0,6285 | < |
| G | Subject 7 | $>$ | 1,7634 |  |  |  |  |  |  |  | 1,7837 |  |  |  |  |  |  |  | 1,3512 |  |  |  |  |  |  |  | 1,123 |  |  |  |  |  |  |  | 0,0545 | < |
| H | Subject 8 | $>$ | 0,858 |  |  |  |  |  |  |  | 0,6663 |  |  |  |  |  |  |  | 0,1945 |  |  |  |  |  |  |  | 1,0735 |  |  |  |  |  |  |  | 0,4515 | $<$ |
| 1 | Subject 9 | $>$ | 1,211 |  |  |  |  |  |  |  | 0,2834 |  |  |  |  |  |  |  | 0,5617 |  |  |  |  |  |  |  | 0,6358 |  |  |  |  |  |  |  | 0,7839 | < |
| J | Subject 10 | $>$ | 2,5395 |  |  |  |  |  |  |  | 0,5762 |  |  |  |  |  |  |  | 2,0421 |  |  |  |  |  |  |  | 0,891 |  |  |  |  |  |  |  | 0,9469 | < |
| K | Subject 11 | $>$ | 1,0621 |  |  |  |  |  |  |  | 0,9981 |  |  |  |  |  |  |  | 0,2069 |  |  |  |  |  |  |  | 0,2952 |  |  |  |  |  |  |  | 1,4453 | < |
| L | Subject 12 | $>$ | 0,8007 |  |  |  |  |  |  |  | 0,78 |  |  |  |  |  |  |  | 0,8581 |  |  |  |  |  |  |  | 0,5839 |  |  |  |  |  |  |  | 0,1419 | $<$ |
| M | Subject 13 | $>$ | 0,8804 |  |  |  |  |  |  |  | 0,0841 |  |  |  |  |  |  |  | 0,2755 |  |  |  |  |  |  |  | 0,1136 |  |  |  |  |  |  |  | -0,2501 | $<$ |
| N | Subject 14 | $>$ | 1,3514 |  |  |  |  |  |  |  | 0,7855 |  |  |  |  |  |  |  | 0,9427 |  |  |  |  |  |  |  | 0,7143 |  |  |  |  |  |  |  | 0,4675 | < |
| 0 | Subject 15 | $>$ | 1,0534 |  |  |  |  |  |  |  | 0,4302 |  |  |  |  |  |  |  | 2,1821 |  |  |  |  |  |  |  | 1,0386 |  |  |  | 0,205 |  |  |  | 0,5874 | $<$ |
| P | Subject 16 | $>$ | 1,0923 |  |  |  |  |  |  |  | 0,1446 |  |  |  |  |  |  |  | 0,5524 |  |  |  |  |  |  |  | 0,6591 |  |  |  |  |  |  |  | 0 | $<$ |
| Q | Subject 17 | $>$ | 1,1644 |  |  |  |  |  |  |  | 0,4892 |  |  |  |  |  |  |  | 0,4306 |  |  |  |  |  |  |  | 0,7426 |  |  |  |  |  |  |  | 0,5833 | < |
| R | Subject 18 | $>$ | 0,6449 |  |  |  |  |  |  |  | 0,063 |  |  |  |  |  |  |  | 0,1744 |  |  |  |  |  |  |  | 0,2685 |  |  |  |  |  |  |  | 0,2192 | < |


| Three syllables |  |  |  | $\frac{\text { Stimulus } 1}{22}$ni.juu.ni |  |  |  |  | $\begin{gathered} \frac{\text { Stimulus } 2}{53} \\ \text { go.juu.san } \end{gathered}$ |  |  |  |  |  | $\frac{\text { Stimulus } 3}{29}$ <br> ni.juu.kyuu |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ \hline 34 \\ \text { san.juu.yon } \\ \hline \end{gathered}$ |  |  |  |  |  | Response <br> time | End click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start <br> click | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 1,1542 |  |  |  |  |  | 0,541 |  |  |  |  |  | 0,1772 |  |  |  |  |  | 0,2889 |  |  |  |  |  | 0,3686 | < |
| B | Subject 2 | $>$ | 0,913 |  |  |  |  |  | 0,7459 |  |  |  |  |  | 0,5889 |  |  |  |  |  | 0,4151 |  |  |  |  |  | 1,2092 | < |
| C | Subject 3 | $>$ | 2,3961 |  |  |  |  |  | 1,0382 |  |  |  |  |  | 0,623 |  |  |  | 0,495 |  | 1,0312 |  | 0,326 |  | 0,355 |  | 1,1064 | < |
| D | Subject 4 | $>$ | 1,0143 |  |  |  |  |  | 0,3697 |  |  |  |  |  | 0,2737 |  |  |  | 0,698 | R | 0,4917 |  |  |  |  |  | 0 | < |
| E | Subject 5 | $>$ | 1,1108 |  |  |  |  |  | 0,0971 |  |  |  |  |  | 0,2593 |  |  |  |  |  | 0,0337 |  |  |  |  |  | 0,3892 | < |
| F | Subject 6 | $>$ | 1,0053 |  |  |  |  |  | 1,6178 |  |  |  |  |  | 0,4622 |  |  |  | 0,378 |  | 0,4613 |  |  |  |  |  | 0,0786 | < |
| G | Subject 7 | $>$ | 1,4663 |  |  |  |  |  | 3,4257 |  |  |  |  |  | 1,2457 |  |  |  |  |  | 2,4095 |  |  |  |  |  | 0 | < |
| H | Subject 8 | $>$ | 1,1482 |  |  |  |  |  | 1,3599 |  |  |  |  |  | 0,4013 |  |  |  |  |  | 0,4239 |  |  |  |  |  | 0,07 | < |
| 1 | Subject 9 | $>$ | 1,0587 |  |  |  |  |  | 0,5402 |  |  |  |  |  | 0,6259 |  |  |  |  |  | 0,5293 |  |  |  |  | NR | 0,5823 | < |
| J | Subject 10 | $>$ | 1,3355 |  |  |  |  |  | 1,8647 |  |  |  |  |  | 0,4284 |  |  |  | 0,397 |  | 0,9171 |  |  |  |  |  | 1,0411 | < |
| K | Subject 11 | $>$ | 1,0921 |  |  |  |  |  | 0,6993 |  |  |  |  |  | 0,3691 |  |  |  |  |  | 0,0842 |  |  |  |  |  | 1,1234 | < |
| L | Subject 12 | $>$ | 0,9392 |  |  |  |  |  | 0,7281 |  |  |  |  |  | 1,1332 |  |  |  |  |  | 0,5657 |  |  |  |  |  | 0,274 | < |
| M | Subject 13 | $>$ | 1,1944 |  |  |  |  |  | 0,1491 |  |  |  |  |  | 0,3254 |  |  |  | 0,372 |  | 0,3131 |  |  |  | 0,292 |  | 0,3786 | < |
| $N$ | Subject 14 | $>$ | 0,8801 |  |  |  |  |  | 1,1107 |  |  |  |  |  | 1,0596 |  |  |  |  |  | 0,9703 |  |  |  |  |  | 0,2355 | < |
| 0 | Subject 15 | $>$ | 0,9878 |  |  |  |  |  | 0,4682 |  |  |  | 0,354 |  | 0,1311 |  |  |  | 0,437 |  | 0,217 |  |  |  |  |  | 0,2938 | < |
| P | Subject 16 | $>$ | 1,3827 |  |  |  |  |  | 0,9742 |  |  |  |  |  | 0,482 |  |  |  |  |  | 0,6398 |  |  |  |  |  | 0,1551 | < |
| Q | Subject 17 | $>$ | 1,0086 |  |  |  |  |  | 0,4977 |  |  |  |  |  | 0,6215 |  |  |  |  |  | 0,5458 |  |  |  |  |  | 0,4995 | < |
| R | Subject 18 | $>$ | 2,3755 |  |  |  |  |  | 0,4658 |  |  |  |  |  | 0,2773 |  |  |  |  |  | 0,3275 |  |  |  |  |  | 0,3475 | < |


| Three syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ 54 \\ \text { go.juu.yon } \end{gathered}$ |  |  |  |  | $\frac{\text { Stimulus } 2}{11} \begin{gathered} \text { juu.i.chi } \end{gathered}$ |  |  |  |  |  | Stimulus 370na.na.juu |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ 25 \\ \text { ni.juu.go } \end{gathered}$ |  |  |  |  |  | Response time | Endclick |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start <br> click | Response <br> time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  | Response time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S 1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 1,6004 |  |  |  |  |  | 2,8683 |  |  |  |  |  | 0,9357 |  |  |  |  |  | 0,593 |  | 0,192 |  | 0,316 |  | 0,3231 | < |
| B | Subject 2 | $>$ | 1,007 |  |  |  |  |  | 0,4463 |  |  |  |  |  | 0,238 |  |  |  |  |  | 0,408 |  |  |  |  |  | 0,5311 | < |
| C | Subject 3 | $>$ | 1,8657 |  |  |  |  |  | 1,1575 |  |  |  |  |  | 0,4085 |  |  |  |  |  | 1,1834 |  |  |  |  |  | 1,1213 | < |
| D | Subject 4 | > | 2,5603 |  |  |  |  |  | 1,4052 |  |  |  |  |  | 2,1368 |  |  |  |  |  | 0,1321 |  |  |  |  |  | 0 | < |
| E | Subject 5 | > | 1,584 |  |  |  |  |  | 0,9176 |  |  |  |  |  | 0,2126 |  |  |  |  |  | 0,0783 |  |  |  |  |  | 0,789 | < |
| F | Subject 6 | $>$ | 1,6615 |  |  |  |  |  | 2,8118 |  |  |  |  |  | 1,1024 |  |  |  |  |  | 1,8373 |  |  |  |  |  | 0,0314 | < |
| G | Subject 7 | $>$ | 1,3961 |  |  |  |  |  | 0,7362 |  |  |  |  |  | 1,9365 |  |  |  |  |  | 1,5312 |  | 0,313 |  |  |  | 0 | < |
| H | Subject 8 | $>$ | 2,0024 |  |  |  |  |  | 0,0553 |  |  |  |  |  | 0,3618 |  |  |  | 0,203 |  | 0,5692 |  |  |  |  |  | 0,246 | < |
| 1 | Subject 9 | $>$ | 1,141 |  |  |  |  |  | 0,6964 |  |  |  |  |  | 0,662 |  |  |  |  |  | 0,4792 |  |  |  |  |  | 0 | < |
| J | Subject 10 | $>$ | 2,5454 |  |  |  |  |  | 1,4019 |  |  |  |  |  | 1,9546 |  |  |  |  |  | 1,0784 |  |  |  | 0,566 |  | 0,3449 | < |
| K | Subject 11 | $>$ | 1,2043 |  |  |  |  |  | 0,602 |  |  |  |  |  | 0,233 |  |  |  |  |  | 0,5019 |  |  |  |  |  | 1,3594 | < |
| L | Subject 12 | $>$ | 0,915 |  |  |  |  |  | 1,3099 |  |  |  |  |  | 0,8216 |  |  |  |  |  | 0,4482 |  |  |  |  |  | 0,2158 | < |
| M | Subject 13 | $>$ | 1,157 |  |  |  |  |  | 0,4901 |  |  |  |  |  | 1,0809 |  |  |  |  |  | 0,6756 |  |  |  |  |  | 1,8119 | < |
| N | Subject 14 | $>$ | 2,3904 |  |  |  | 0,411 |  | 0,8497 |  |  |  |  |  | 0,5964 |  |  |  |  |  | 0,7026 |  |  |  |  |  | 0,502 | < |
| 0 | Subject 15 | $>$ | 1,8898 |  |  |  |  |  | 1,3671 |  |  |  |  |  | 3,0156 |  |  |  |  |  | 1,5681 |  |  |  |  |  | 0,2679 | < |
| P | Subject 16 | $>$ | 1,538 |  |  |  |  |  | 0,2811 |  |  |  |  |  | 1,9397 |  |  |  |  |  | 1,9262 |  |  |  |  |  | 0,1876 | < |
| Q | Subject 17 | $>$ | 0,9878 |  |  |  |  |  | 0,4195 |  |  |  |  |  | 0,7193 |  |  |  |  |  | 0,5466 |  |  |  |  |  | 0,6191 | < |
| R | Subject 18 | $>$ | 2,2761 |  |  |  |  |  | 0,189 |  |  |  |  |  | 0,5414 |  |  |  |  |  | 0,6001 |  |  |  |  |  | 0,5679 | < |


| Three syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline 99 \\ \text { kyuu.juu.kyuu } \end{gathered}$ |  |  |  |  | Stimulus 235san.juu.go |  |  |  |  |  | Stimulus 3 <br> 24 <br> ni.juu.yon |  |  |  |  |  | Stimulus 418juu.ha.chi |  |  |  |  |  | Response time | Endclick |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start <br> click | Response time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  | Responsetime | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  |
|  |  |  |  | S 1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S 2 | Pause | S3 |  | S 1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 2,7985 |  |  |  |  |  | 0,5722 |  |  |  |  |  | 1,0391 |  |  |  |  |  | 5,5605 |  |  |  |  |  | 0,6345 | $<$ |
| B | Subject 2 | $>$ | 0,9311 |  |  |  |  |  | 0,2971 |  |  |  |  |  | 0,498 |  |  |  |  |  | 0,5296 |  |  |  |  |  | 0,5728 | $<$ |
| C | Subject 3 | $>$ | 3,0133 |  |  |  |  |  | 0,4493 |  |  |  |  |  | 0,4281 |  |  |  |  |  | 1,958 |  |  |  |  |  | 0,877 | < |
| D | Subject 4 | $>$ | 5,5496 |  |  |  | 0,831 | NR | 0,73 |  |  |  |  |  | 0,1606 |  |  |  | 0,429 |  | 3,0016 |  |  |  |  |  | 0,0109 | < |
| E | Subject 5 | $>$ | 1,6543 |  |  |  | 0,24 |  | 0 |  |  |  |  |  | 0,191 |  |  |  |  |  | 0,6412 |  |  |  |  |  | 0,0611 | < |
| F | Subject 6 | $>$ | 1,847 |  |  |  | 0,56 |  | 0,4367 |  |  |  |  |  | 0,5038 |  |  |  |  |  | 1,2272 |  |  |  |  |  | 0,3752 | < |
| G | Subject 7 | $>$ | 2,6757 |  |  |  |  |  | 0,8483 |  |  |  |  |  | 1,0964 |  |  |  |  |  | 1,8011 |  |  |  |  |  | 0,1035 | < |
| H | Subject 8 | $>$ | 1,4577 |  |  |  |  |  | 0,0942 |  |  |  |  |  | 0,2997 |  |  |  |  |  | 0,5994 |  |  |  | 0,166 |  | 0 | < |
| 1 | Subject 9 | $>$ | 1,731 |  |  |  |  |  | 0,5291 |  |  |  |  |  | 0,5523 |  |  |  |  |  | 0,312 |  |  |  |  |  | 0,8562 | < |
| J | Subject 10 | $>$ | 1,2524 |  |  |  |  |  | 0,5039 |  |  |  | 0,717 |  | 1,049 |  |  |  |  |  | 2,023 |  |  |  |  |  | 0 | < |
| K | Subject 11 | $>$ | 1,0839 |  |  |  |  |  | 0,5598 |  |  |  | 0,579 |  | 0,4943 |  |  |  |  |  | 0,9799 |  |  |  |  |  | 1,2183 | < |
| L | Subject 12 | $>$ | 0,9358 |  |  |  |  |  | 0,3531 |  |  |  |  |  | 0,7978 |  |  |  |  |  | 2,1324 | R |  |  |  |  | 0 | < |
| M | Subject 13 | $>$ | 0,9254 | NR |  |  |  | NR | 0,4794 |  |  |  |  |  | 0,1529 |  |  |  |  |  | 0,5936 |  |  |  |  |  | 0 | < |
| N | Subject 14 | $>$ | 1,4034 |  |  |  |  |  | 1,1557 |  |  |  |  |  | 0,9279 |  |  |  |  |  | 1,1415 |  |  |  |  |  | 0,6144 | < |
| 0 | Subject 15 | $>$ | 1,0813 |  |  |  |  |  | 0,3675 |  |  |  |  |  | 0,1755 |  |  |  |  |  | 2,4317 |  |  |  |  |  | 0 | < |
| P | Subject 16 | $>$ | 1,3294 |  |  |  |  |  | 1,5711 |  |  |  |  |  | 0,2824 |  |  |  |  |  | 1,5953 |  |  |  |  |  | 0,2427 | < |
| Q | Subject 17 | $>$ | 1,0813 |  |  |  |  |  | 0,393 |  |  |  |  |  | 0,2013 |  |  |  |  |  | 0,6401 |  |  |  |  |  | 0,6571 | < |
| R | Subject 18 | $>$ | 0,967 |  |  |  |  |  | 0,1018 |  |  |  |  |  | 0,268 |  |  |  |  |  | 0,135 |  |  |  |  |  | 0 | < |


| Three syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline 55 \\ \text { go.juu.go } \\ \hline \end{gathered}$ |  |  |  |  | Stimulus 294kyuu.juu.yon |  |  |  |  |  | $\frac{\text { Stimulus } 3}{80}$ <br> ha.chi.juu |  |  |  |  |  | Stimulus 443yon.juu.san |  |  |  |  |  | Response <br> time | $\begin{array}{\|l\|} \hline \text { End } \\ \text { click } \\ \hline \end{array}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start <br> click | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | > | 1,9333 |  |  |  |  |  | 0,7448 |  |  |  |  |  | 5,5613 |  |  |  |  |  | 1,1499 |  |  |  |  |  | 0,53 | < |
| B | Subject 2 | $>$ | 1,0973 |  |  |  |  |  | 0,8 |  |  |  |  |  | 0,7667 |  |  |  |  |  | 0,7325 |  |  |  |  |  | 0,9386 | < |
| C | Subject 3 | $>$ | 1,3504 |  |  |  |  |  | 0,8283 |  |  |  | 0,276 |  | 1,358 |  |  |  |  |  | 2,1391 |  |  |  |  |  | 0,5657 | < |
| D | Subject 4 | $>$ | 2,0022 |  |  |  |  |  | 1,0942 |  |  |  | 0,233 |  | 0,7524 |  |  |  |  |  | 1,2349 |  |  |  |  |  | -0,2478 | < |
| E | Subject 5 | $>$ | 1,176 |  |  |  |  |  | 0,0685 |  |  |  |  |  | 0,2811 |  |  |  |  |  | 0,0503 |  |  |  |  |  | 0,6326 | < |
| F | Subject 6 | $>$ | 1,462 |  |  |  |  |  | 0,66 |  |  |  |  |  | 0,9903 |  |  |  |  | NR | 0,5664 |  |  |  |  |  | 0,3419 | < |
| G | Subject 7 | $>$ | 1,5188 |  |  |  |  |  | 4,3275 |  |  |  | 0,173 |  | 0,8955 |  |  |  |  |  | 1,9756 |  |  |  |  |  | 0,4267 | < |
| H | Subject 8 | $>$ | 0,8412 |  |  |  |  |  | 0,973 |  |  |  | 0,212 |  | 0,6959 |  |  |  |  |  | 1,4089 |  |  |  |  |  | 0,0882 | < |
| 1 | Subject 9 | $>$ | 1,0707 |  |  |  |  |  | 0,5102 |  |  |  |  |  | 0,7653 |  |  |  |  |  | 0,6257 |  |  |  |  |  | 0,5861 | < |
| J | Subject 10 | $>$ | 1,3096 |  |  |  |  |  | 0,9694 |  |  |  | 1,391 | R | 0,35878 |  |  |  |  |  | 1,4221 |  |  |  |  |  | 0,7204 | < |
| K | Subject 11 | $>$ | 1,4012 |  |  |  |  |  | 0,3747 |  |  |  |  |  | 0,1421 |  |  |  |  |  | 0,5457 |  |  |  |  |  | 0,7491 | < |
| L | Subject 12 | > | 1,3644 |  |  |  |  |  | 0,9988 |  |  |  |  |  | 0,9529 |  |  |  |  |  | 0,7923 |  |  |  |  |  | 0,0908 | < |
| M | Subject 13 | > | 0,8001 |  |  |  |  |  | 0,1891 |  |  |  |  |  | 0,6242 |  |  |  |  |  | 0,1565 |  |  |  |  |  | 0,0784 | < |
| N | Subject 14 | $>$ | 1,0845 |  |  |  |  |  | 1,1291 |  |  |  |  |  | 0,8176 |  |  |  |  |  | 1,1737 |  |  |  |  |  | 1,0697 | < |
| 0 | Subject 15 | $>$ | 2,3791 |  |  |  |  |  | 0,2683 |  |  |  |  |  | 0,5355 |  |  |  | 0,191 |  | 0,9831 |  |  |  |  |  | 0 | < |
| P | Subject 16 | $>$ | 1,0191 |  |  |  |  |  | 0,4014 |  |  |  |  |  | 0,3484 |  |  |  |  |  | 0,683 |  |  |  |  |  | 0,1264 | < |
| Q | Subject 17 | $>$ | 1,5072 |  |  |  |  |  | 0,8527 |  |  |  |  |  | 0,4187 |  |  |  |  |  | 0,6776 |  |  |  |  |  | 0,3092 | < |
| R | Subject 18 | $>$ | 0,5728 |  |  |  |  |  | 0,4893 |  |  |  |  |  | 0,241 |  |  |  |  |  | 0,7072 |  |  |  |  |  | 0,3324 | < |

## c．NNNW stimuli type

| Five syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ 76 \\ \text { na..na.ju.ro..ku } \end{gathered}$ |  |  |  |  |  |  |  |  |  | Stimulus 287ha．chi．juu．na．na |  |  |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus 3 } \\ 61 \\ \text { ro.ku.juu.i.chi } \end{gathered}$ |  |  |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ \text { L゙どうはんばいき } \\ \text { ji.dou.han.bai.ki } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  |  | Response <br> time |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| sn | Pseudonym | Start | Response | Reading |  |  |  |  |  |  |  |  | Responsetime | Reading |  |  |  |  |  |  |  |  | Response | Reading |  |  |  |  |  |  |  |  | $\begin{array}{\|c\|} \hline \text { Response } \\ \text { time } \\ \hline \end{array}$ | Reading |  |  |  |  |  |  |  |  |  |  |
|  |  | click | time | S1 | Pause | 52 | Pause | 53 | Pause | 54 | Pause | 55 |  | S1 | Pause | S2 | Pause | 53 | Pause | s4 | Pause | 55 |  | s1 | Pause | S2 | Pause | 53 | Pause | 54 | Pause | 55 |  | S1 | Pause | s2 | Pause | 53 | Pause | s4 | Pause | 55 |  |  |
| A | Subject 1 | $>$ | 1，6286 |  |  |  |  |  |  |  |  |  | 2，1801 |  |  |  |  |  | 0，718 |  |  |  | 0，5741 |  |  |  |  |  |  |  |  |  | 0，4156 |  |  |  |  |  | 0，218 |  |  |  | 0，4683 | $<$ |
| B | Subject 2 | $>$ | 1，2375 |  |  |  |  |  |  |  |  |  | 0，5425 |  |  |  |  |  |  |  |  |  | 0，6639 |  |  |  |  |  |  |  |  |  | 0，9101 |  |  |  |  |  |  |  |  |  | 1，6611 | $<$ |
| c | Subject 3 | $>$ | 1，4896 |  |  |  |  |  | 0，314 |  |  |  | 0，9562 |  |  |  | 0，458 |  | 0，271 |  |  |  | 1，5566 |  |  |  |  |  |  |  |  |  | 2，1462 |  |  | NR |  |  |  |  |  |  | 0，3459 | $<$ |
| D | Subject 4 | $>$ | 1，4788 |  |  |  |  |  | 0，25 |  |  |  | 0，2767 |  |  |  |  |  | 0，526 |  |  |  | 2，6045 |  |  |  |  |  |  |  |  |  | 2，4296 |  |  |  |  |  |  |  |  |  | －0，1158 | $<$ |
| E | Subject 5 | $>$ | 1，5326 |  |  |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  |  |  | 0，1422 |  |  |  |  |  |  |  |  |  | 0，539 |  |  |  |  |  |  |  |  |  | 0，065 | $<$ |
| F | Subject 6 | $>$ | 2，1115 |  |  |  |  |  |  |  |  |  | 1，2073 |  |  |  |  |  |  |  |  |  | 1，0778 |  |  |  |  |  |  |  |  |  | 2，652 |  |  |  |  |  |  |  |  |  | 0，1541 | $<$ |
| 6 | Subject 7 | $>$ | 0，6749 |  |  |  |  |  |  |  |  |  | 1，3533 |  |  |  |  |  |  |  |  |  | 2，7909 |  |  |  |  |  |  |  |  |  | 0，6743 |  |  |  |  |  |  |  |  |  | 0，9356 | $<$ |
| H | Subject 8 | $>$ | 1，4441 |  |  |  |  |  |  |  |  |  | 0，0472 |  | 0，4 |  |  |  |  |  |  |  | 0，911 |  |  |  |  |  |  |  |  |  | 1，0397 |  |  |  |  |  |  |  |  |  | 0，196 | $<$ |
| 1 | Subject 9 | $>$ | 1，6416 |  |  |  |  |  |  |  |  |  | 0，9794 |  |  |  |  |  |  |  |  |  | 0，8437 |  |  |  |  |  |  |  |  |  | 1，0692 |  |  |  |  |  |  |  |  |  | 1，0843 | $<$ |
| ， | Sujject 10 | $>$ | 1，2197 |  |  |  |  |  | 0，19 |  |  |  | 0，5347 |  |  |  |  |  |  |  |  |  | 1，7237 |  |  |  |  |  |  |  |  |  | 1，304 |  |  |  |  |  |  |  |  |  | 0，186 | $<$ |
| K | Subject 11 | $>$ | 1，2725 |  |  |  |  |  |  |  |  |  | 0，0929 |  |  |  |  |  |  |  |  |  | 0，5639 |  |  |  |  |  |  |  |  |  | 0，6416 |  |  |  |  |  |  |  |  |  | 1，4569 | $<$ |
| $\llcorner$ | Subject 12 | $>$ | 1，2455 |  |  |  |  |  |  |  |  |  | 0，4839 |  |  |  |  |  | 1，371 |  |  |  | 0，4524 |  |  |  |  |  |  |  |  |  | 0，5837 |  |  |  |  |  |  |  |  |  | 0，1053 | $<$ |
| M | Subject 13 | $>$ | 2，4737 |  |  |  |  |  |  |  |  |  | 0，1086 |  |  |  |  |  | 0，86 |  |  |  | 0，6761 |  |  |  |  |  |  |  |  |  | 0，2752 |  |  |  |  |  |  |  |  |  | 0，317 | ＜ |
| $\cdots$ | Subject 14 | $>$ | 1，5855 |  |  |  |  |  |  |  |  |  | 0，867 |  |  |  |  |  |  |  |  |  | 0，7598 |  |  |  |  |  |  |  |  |  | 3，217 |  |  |  | 0，333 |  |  |  |  |  | 1，5016 | $<$ |
| $\bigcirc$ | Subject 15 | $>$ | 1，4593 |  |  |  |  |  | 0，431 |  |  |  | 0，4377 |  |  |  |  |  | 3，658 | ＊ |  |  | 2，276 |  |  |  |  |  |  |  |  |  | 2，2272 |  |  |  |  |  | 0，862 |  |  |  |  | $<$ |
| P | Subject 16 | $>$ | 1，7941 |  |  |  |  |  |  |  |  |  | 0，1856 |  |  |  |  |  |  |  |  |  | 0，8731 |  |  |  |  |  |  |  |  |  | 1，4024 |  |  |  |  |  |  |  |  |  | 0，4997 | $<$ |
| Q | Subject 17 | $>$ | 2，1619 |  |  |  |  |  |  |  |  |  | 0，485 |  |  |  |  |  |  |  |  |  | 0，7024 |  |  |  |  |  |  |  |  |  | 0，7526 |  |  |  |  |  |  |  |  |  | 0，7944 | $<$ |
| R | Subject 18 | $>$ | 1，2267 |  |  |  |  |  |  |  |  |  | 0，1998 |  |  |  |  |  |  |  |  |  | 1，019 |  |  |  |  |  |  |  |  |  | 1，2371 |  |  |  | 0，653 |  |  |  |  |  | 0，2698 | ＜ |



| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ 65 \\ \text { ro.ku.juu.go } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  | Stimulus 227ni．juu．na．na |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 3 \\ \hline 84 \\ \text { ha.chi.juu.yon } \\ \hline \end{gathered}$ |  |  |  |  |  |  |  | $\begin{aligned} & \text { Stimulus } 4 \\ & \text { びじゅつかん } \\ & \text { bi.jyu.tsu.kan } \\ & \hline \end{aligned}$ |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \\ \hline \end{gathered}$ | （End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start | Response |  |  |  |  |  |  |  | Reading |  |  |  |  |  |  | Response time | Reading |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \\ \hline \end{gathered}$ | Reading |  |  |  |  |  |  | Responsetime |  |  | Reading |  |  |  |  |  |  |
|  |  | click | time | S1 | Pause | S2 | Pause | 53 | Pause | 54 | S1 | Pause | S2 | Pause | 53 | Pause | S4 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |  |
| A | Subject 1 | $>$ | 1，3885 |  |  |  |  |  |  |  | 0，4347 |  |  |  | 0，668 | R |  |  | 4，1314 |  |  | NR |  |  |  |  | 1，3399 |  |  |  | 0，325 |  |  |  | 0，8111 | $<$ |
| B | Subject 2 | $>$ | 1，0342 |  |  |  |  |  |  |  | 1，1283 |  |  |  |  |  |  |  | 0，7033 |  |  |  |  |  |  |  | 1，2584 |  |  |  |  |  |  |  | 1，1603 | $<$ |
| c | Subject 3 | $>$ | 1，765 |  |  |  |  |  |  |  | 1，3829 |  |  |  |  |  |  |  | 1，4375 |  |  |  | 0，212 |  |  |  | 1，7286 |  |  |  |  |  |  |  | 0，2494 | ＜ |
| D | Subject 4 | $>$ | 1，5567 |  |  |  |  |  |  |  | 0，1914 |  |  |  | 0，222 | R |  |  | 0，4055 |  |  |  |  |  | 0，327 |  | 2，4725 |  |  |  |  |  |  |  | 0 | ＜ |
| E | Subject 5 | $>$ | 1，1598 |  |  |  |  |  |  |  | 0，0991 |  |  |  |  |  |  |  | 0，0564 |  |  |  |  |  |  |  | 0，9374 |  |  |  |  |  |  |  | 0，1373 | $<$ |
| F | Subject 6 | $>$ | 1，0443 |  |  |  |  |  |  |  | 1，1037 |  |  |  | 0，559 |  |  |  | 1，8157 |  |  |  |  |  |  |  | 1，6615 |  |  |  |  |  |  |  | 0，1627 | ＜ |
| G | Subject 7 | $>$ | 1，6555 |  |  |  |  |  |  |  | 2，0643 |  |  |  |  |  |  |  | 2，4463 |  |  |  |  |  |  |  | 1，3387 |  |  |  |  |  |  |  | 0，0442 | $<$ |
| H | Subject 8 | $>$ | 1，4787 |  |  |  |  |  |  |  | 0，6794 |  |  |  |  |  |  |  | 0，3067 |  |  |  |  |  |  |  | 0，5477 |  |  |  |  |  |  |  | 0，2529 | ＜ |
| 1 | Subject 9 | $>$ | 1，5767 |  |  |  |  |  |  |  | 0，4505 |  |  |  |  |  |  |  | 0，5696 |  |  |  |  |  |  |  | 0，4614 |  |  |  |  |  |  |  | 0，9811 | ＜ |
| J | Subject 10 | $>$ | 2，294 |  |  |  |  |  |  |  | 1，2056 |  |  |  |  |  |  |  | 0，3516 |  |  |  |  |  | 0，433 |  | 1，2798 |  |  |  |  |  |  |  |  | $<$ |
| K | Subject 11 | $>$ | 0，952 |  |  |  |  |  |  |  | 0，3666 |  |  |  |  |  |  |  | 0，3349 |  |  |  |  |  |  |  | 1，5156 |  | 0，515 |  | 0，283 |  |  |  | 0，1129 | ＜ |
| L | Subject 12 | $>$ | 0，8735 |  |  |  |  |  |  |  | 0，5449 |  |  |  | 0，274 |  |  |  | 0，88 |  |  |  |  |  |  |  | 0，8216 |  |  |  |  |  |  |  | 0，1531 | $<$ |
| M | Subject 13 | $>$ | 1，0097 |  |  |  |  |  | 0，307 |  | 0，1414 |  |  |  | 0，227 |  |  |  | 0，1863 |  |  |  |  |  |  |  | 0，6061 |  |  |  |  |  |  |  | 0，407 | ＜ |
| N | Subject 14 | $>$ | 3，1904 |  |  |  |  |  |  |  | 1，0178 |  |  |  |  |  |  |  | 0，8957 |  |  |  |  |  |  |  | 1，4437 |  | 0，269 |  | 0，249 |  |  | R | 1，3353 | ＜ |
| $\bigcirc$ | Subject 15 | $>$ | 4，3781 |  |  |  |  |  |  |  | 0，1695 |  |  |  | 1，142 |  |  |  | 3，2515 |  |  |  |  |  |  |  | 1，2729 |  | 0，484 |  |  |  |  |  | －0，2377 | $<$ |
| P | Subject 16 | $>$ | 0，9322 |  |  |  |  |  |  |  | 0，4829 |  |  |  |  |  |  |  | 0，5364 |  |  |  |  |  |  |  | 1，7252 |  |  |  |  |  |  |  | 0，3345 | $<$ |
| Q | Subject 17 | $>$ | 1，2399 |  |  |  |  |  |  |  | 0，9151 |  |  |  |  |  |  |  | 0，3242 |  |  |  |  |  |  |  | 0，7538 |  |  |  |  |  |  |  | 0，6868 | ＜ |
| R | Subject 18 | $>$ | 0，7903 |  |  |  |  |  | 0，437 |  | 0，8216 |  |  |  |  |  |  |  | 0，2951 |  |  |  |  |  |  |  | 2，0579 |  |  |  |  |  |  |  | 0，8631 | ＜ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus 1 } \\ 37 \\ \text { san.juu.na.na } \end{gathered}$ |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 2 \\ 58 \\ \text { go.juu.ha.chi } \end{gathered}$ |  |  |  |  |  |  |  |  | Stimulus 3 <br> 72 <br> na．na．juu．ni |  |  |  |  |  |  | Stimulus 4ひきだしhi．ki．da．shi |  |  |  |  |  |  |  | Response <br> time | （End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | $\begin{array}{\|l\|l\|l\|l\|l\|l\|l\|} \hline \text { stick } \\ \text { clik } \end{array}$ | Response time |  |  |  |  |  |  |  | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  | Response time | Reading |  |  |  |  |  |  | Response time |  |  | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | 52 | Pause | 53 | Pause | 54 | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | S4 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |  |
| A | Subject 1 | $>$ | 5，1678 |  |  |  |  |  |  |  | 0，5742 |  |  |  | 0，722 |  |  |  | 1，8376 |  |  |  |  |  |  |  | 0，6561 |  |  |  |  |  |  |  | 0，6553 | ＜ |
| B | Subject 2 | $>$ | 1，0808 |  |  |  |  |  |  |  | 0，4785 |  |  |  |  |  |  |  | 0，4389 |  |  |  |  |  |  |  | 0，9663 |  |  |  |  |  |  |  | 0，991 | $<$ |
| c | Subject 3 | $>$ | 1，2069 |  |  |  |  |  |  |  | 0，2531 |  |  |  | 0，196 |  |  |  | 0，911 |  |  |  |  |  |  |  | 1，3597 |  |  |  |  |  |  |  | 0，3167 | $<$ |
| D | Subject 4 | $>$ | 1，0477 |  |  |  | 0，338 |  |  |  | 0，6838 |  |  |  |  |  |  |  | 0，8945 |  |  |  |  |  |  |  | 1，3458 |  |  |  |  |  |  |  | 0，4022 | $<$ |
| E | Subject 5 | $>$ | 1，021 |  |  |  |  |  |  |  | 0，1983 |  |  |  |  |  |  |  | 0，0674 |  |  |  |  |  |  |  | 0，3331 |  |  |  |  |  |  |  | 0，2103 | ＜ |
| F | Subject 6 | $>$ | 1，3202 |  |  |  | 0，397 |  |  |  | 0，9227 |  |  |  |  |  |  |  | 0，5888 |  |  |  |  |  |  |  | 2，109 |  |  |  |  |  |  |  | 0，1628 | $<$ |
| G | Subject 7 | $>$ | 1，5901 |  |  |  | 0，404 |  |  |  | 0，8291 |  |  |  |  |  |  |  | 0，9084 | NR |  | NR | 0，315 |  |  |  | 1，7794 |  |  |  |  |  |  |  | 0，4368 | $<$ |
| H | Subject 8 | $>$ | 1，228 |  |  |  |  |  |  |  | 1，2159 |  |  |  |  |  |  |  | 0，1757 |  |  |  |  |  |  |  | 0，5183 |  |  |  |  |  |  |  |  | ＜ |
| 1 | Subject 9 | $>$ | 1，2091 |  |  |  |  |  |  |  | 0，5993 |  |  |  | 0，193 |  |  |  | 0，428 |  |  |  |  |  |  |  | 0，4869 |  |  |  |  |  |  |  | 0，2459 | $<$ |
| J | Subject 10 | $>$ | 3，7791 |  |  |  |  |  |  |  | 2，1695 |  |  |  |  |  |  |  | 1，3472 |  |  |  |  |  |  |  | 0，7775 |  |  |  |  |  |  |  | 0，08382 | $<$ |
| K | Subject 11 | $>$ | 0，9569 |  |  |  |  |  |  |  | 0，7329 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 0，3672 |  |  |  |  |  |  |  | 0，4697 | ＜ |
| L | Subject 12 | $>$ | 1，2764 |  |  |  |  |  |  |  | 0，5934 |  |  |  |  |  |  |  | 1，4242 |  |  |  |  |  |  |  | 0，832 |  |  |  |  |  |  |  | 0，1064 | $<$ |
| M | Subject 13 | $>$ | 0，9412 |  |  |  | 0，354 |  |  |  | 0，1999 |  |  |  |  |  |  |  | 0，6553 |  |  |  |  |  |  |  | 0，2097 |  |  |  |  |  |  |  | 0 | ＜ |
| N | Subject 14 | $>$ | 1，0813 |  |  |  | 0，201 |  |  |  | 0，5771 |  |  |  |  |  |  |  | 0，5174 |  |  |  |  |  | 0，719 |  | 2，361 |  |  |  |  |  |  |  | 0，2659 | ＜ |
| 0 | Subject 15 | $>$ | 0，9774 |  |  |  |  |  |  |  | 0，2472 |  |  |  | 0，276 |  |  |  | 2，1532 |  |  |  |  |  | 0，531 |  | 0，593 |  |  |  |  |  |  |  |  | $<$ |
| P | Subject 16 | $>$ | 1，2199 |  |  |  |  |  |  |  | 0，3324 |  |  |  |  |  |  |  | 0，1746 |  |  |  |  |  |  |  | 0，7805 |  |  |  |  |  |  |  | 0，3857 | ＜ |
| Q | Subject 17 | $>$ | 1，1852 |  |  |  |  |  |  |  | 0，4788 |  |  |  | 0，171 |  |  |  | 0，8316 |  |  |  |  |  |  |  | 0，62 |  |  |  |  |  |  |  | 0，856 | ＜ |
| R | Subject 18 | $>$ | 0，6144 |  |  |  |  |  |  |  | 0，1729 |  |  |  |  |  |  |  | 0，2227 |  |  |  |  |  |  |  | 0，7073 |  |  |  |  |  |  |  | 0，069 | ＜ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline 38 \\ \text { san.juu.ha.chi } \end{gathered}$ |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus 2 } \\ \hline 97 \\ \text { kyuu.juu.na.na } \end{gathered}$ |  |  |  |  |  |  | Stimulus 3 <br> ni．juu．ro．ku |  |  |  |  |  |  |  |  | Stimulus 4 よみかた yo．mi．ka．ta |  |  |  |  |  |  | $\begin{gathered} \text { Response } \\ \text { time } \end{gathered}$ | （End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | $\begin{array}{\|c\|c\|c\|c\|c\|c\|} \hline \text { start } \\ \text { clik } \end{array}$ | Response time |  |  |  |  |  |  |  | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  | Response <br> time |  |  | Reading |  |  |  |  |  |  |
| sN |  |  |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 | s1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | S4 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |  |
| A | Subject 1 | $>$ | 1，6442 |  |  |  |  |  |  |  | 2，2858 |  |  |  | 1，16 |  |  |  | 0，4163 |  |  |  |  |  |  |  | 0，4579 |  |  |  |  |  |  |  | 1，2938 | $<$ |
| B | Subject 2 | $>$ | 0，9813 |  |  |  |  |  |  |  | 1，0032 |  |  |  |  |  |  |  | 0，914 |  |  |  |  |  |  |  | 1，0937 |  |  |  |  |  |  |  | 1，3826 | $<$ |
| c | Subject 3 | $>$ | 1，6024 |  | 0，316 |  | 0，393 |  |  |  | 0，964 |  |  |  |  |  |  |  | 0，1918 |  |  |  |  |  |  |  | 0，6662 |  |  |  |  |  |  |  | 0，3123 | $<$ |
| D | Subject 4 | $>$ | 1，428 |  |  |  | 0，322 | R |  |  | 1，7678 |  |  |  |  |  |  |  | 0，5501 |  |  |  | 0，339 |  |  |  | 0，61456 |  |  |  |  | R |  |  | 0 | ＜ |
| E | Subject 5 | $>$ | 1，1923 |  |  |  |  |  |  |  | 0，3219 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 0，2103 |  |  |  |  |  |  |  | 0 | $<$ |
| F | Subject 6 | $>$ | 1，5662 |  |  |  |  |  |  |  | 1，2121 |  |  |  | 2，01 |  |  |  | 1，12 |  |  |  |  |  |  |  | 0，9974 |  |  |  |  |  |  |  | 0，1631 | $<$ |
| G | Subject 7 | $>$ | 1，5585 |  |  |  |  |  |  |  | 0，6499 |  |  |  |  |  | 0，127 |  | 0，1608 |  |  |  |  |  |  |  | 1，0645 |  |  |  |  |  |  |  | 0，3069 | $<$ |
| H | Subject 8 | $>$ | 1，2765 |  |  |  |  |  |  |  | 0，3239 |  |  |  |  |  |  |  | 0，3455 |  |  |  | 0，219 |  |  |  | 0，4827 |  |  |  |  | NR |  |  | 0，3153 | $<$ |
| 1 | Subject 9 | $>$ | 0，9853 |  |  |  |  |  |  |  | 0，7 |  |  |  |  |  |  |  | 0，5451 |  |  |  |  | R | 0，285 |  | 0，3401 |  |  |  |  |  |  |  | 0，6379 | $<$ |
| J | Subject 10 | $>$ | 1，3977 |  |  |  |  |  |  |  | 1，9353 |  |  |  |  |  |  |  | 0，5932 |  |  |  | 0，201 |  |  |  | 1，0947 |  |  |  |  |  |  |  | 0，4343 | $<$ |
| K | Subject 11 | $>$ | 1，4186 |  |  |  |  |  |  |  | 0，3421 |  |  |  |  |  |  |  | 0，5522 |  |  |  |  |  |  |  | 0，6811 |  |  |  |  |  |  |  | 0，3192 | $<$ |
| L | Subject 12 | $>$ | 1，0817 |  |  |  |  |  |  |  | 0，5192 |  |  |  |  |  |  |  | 0，7347 |  |  |  |  |  |  |  | 1，2246 |  |  |  |  |  |  |  | 0 | $<$ |
| M | Subject 13 | $>$ | 1，0114 |  |  |  |  |  |  |  | 0，1099 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 0，4585 |  |  |  |  |  |  |  | 0，2428 | ＜ |
| N | Subject 14 | $>$ | 2，7956 | NR |  | NR |  |  |  |  | 1，2522 |  |  |  |  |  |  |  | 0，9225 |  |  |  |  |  |  |  | 2，1741 |  |  |  |  | NR |  |  | 0，2867 | $<$ |
| 0 | Subject 15 | $>$ | 1，0567 |  |  |  |  |  |  |  | 1，0886 |  |  |  |  |  |  |  | 0，3956 |  |  |  | 0，333 |  |  |  | 0，3852 |  |  |  |  |  |  |  | 0，4069 | $<$ |
| P | Subject 16 | $>$ | 1，0899 |  |  |  |  |  |  |  | 0，4483 |  |  |  |  |  |  |  | 0，284 |  |  |  |  |  |  |  | 1，0734 |  |  |  |  |  |  |  | 0，0732 | ＜ |
| Q | Subject 17 | $>$ | 1，206 |  |  |  |  |  |  |  | 0，1639 |  |  |  |  |  |  |  | 0，5576 |  |  |  |  |  |  |  | 0，3665 |  |  |  |  |  |  |  | 0，171 | $<$ |
| R | Subject 18 | $>$ | 0，8735 |  |  |  |  |  |  |  | 0，1227 |  |  |  |  |  |  |  | 0，15 |  |  |  |  |  |  |  | 0，3149 |  |  |  | 0，32 |  |  |  | 0，3739 | $<$ |


| Three syllables |  |  |  | Stimulus 133san．juu．san |  |  |  |  | $\frac{\text { Stimulus } 2}{92}$ <br> kyuu．juu．ni |  |  |  |  |  | Stimulus 3 <br> 17 <br> juu．na．na |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ \hline \text { かぞく } \\ \text { ka.zo.ku } \\ \hline \end{gathered}$ |  |  |  |  |  | Response time | End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start <br> click | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 0，6005 |  |  |  |  |  | 0，3899 |  |  |  |  | R | 2，8752 |  |  |  |  |  | 0，5544 |  |  |  |  |  | 0，098 | ＜ |
| B | Subject 2 | $>$ | 0，6255 |  |  |  |  |  | 0，5168 |  |  |  |  |  | 0，8273 |  |  |  |  |  | 0，4768 |  |  |  |  |  | 0，6721 | ＜ |
| C | Subject 3 | $>$ | 1，4475 |  |  |  |  |  | 1，3736 |  |  |  | 0，216 |  | 0，9169 |  |  |  |  |  | 1，2111 |  |  |  |  |  | 0，325 | ＜ |
| D | Subject 4 | $>$ | 2，7387 |  |  |  |  |  | 1，4001 |  |  |  |  |  | 1，3539 |  |  | 0，554 |  |  | 0，6288 |  |  |  |  |  | 0 | ＜ |
| E | Subject 5 | $>$ | 1，5854 |  |  |  |  |  | 0，0813 |  |  |  |  |  | 1，9265 |  |  |  |  |  | 0，5094 |  |  |  |  |  | 0 | ＜ |
| F | Subject 6 | $>$ | 2，1686 |  |  |  |  |  | 1，9673 |  |  |  |  |  | 1，4096 |  |  |  |  |  | 0，9455 |  |  |  |  |  | 0，029 | ＜ |
| G | Subject 7 | $>$ | 2，8934 |  |  |  |  |  | 3，1786 |  |  |  |  |  | 3，9122 |  |  |  |  |  | 0，6792 |  |  |  |  |  | 0，0382 | ＜ |
| H | Subject 8 | $>$ | 0，9117 |  |  |  |  |  | 0，2889 |  |  |  |  |  | 1，3713 |  |  |  |  |  | 0，6674 |  |  |  |  |  | －0，1457 | ＜ |
| 1 | Subject 9 | $>$ | 1，1667 |  |  |  |  |  | 0，3994 |  |  |  |  |  | 0，6524 |  |  |  |  |  | 0，3833 |  |  |  |  |  | 0，5828 | ＜ |
| J | Subject 10 | $>$ | 1，1851 |  |  |  |  |  | 0，9399 |  |  |  |  |  | 1，7981 |  |  |  |  |  | 1，3179 |  |  |  |  |  | 0，0433 | ＜ |
| K | Subject 11 | $>$ | 0，8665 |  |  |  |  |  | 0，4693 |  |  |  |  |  | 0，6875 |  | 0，746 |  |  |  | 0，3079 |  |  |  |  | NR | 1，4259 | ＜ |
| L | Subject 12 | $>$ | 0，7331 |  |  |  |  |  | 0，4168 |  |  |  |  |  | 0，6024 |  |  |  |  |  | 0，2475 |  |  |  |  |  | 0，2484 | ＜ |
| M | Subject 13 | $>$ | 1，058 |  |  |  |  |  | 0，2277 |  |  |  |  |  | 1，1956 |  | 0，278 |  |  |  | 0，2889 |  |  |  |  |  | 0，0656 | ＜ |
| N | Subject 14 | $>$ | 3，0138 |  |  |  |  |  | 0，6 |  |  |  |  |  | 1，1847 |  |  |  |  |  | 0，9156 |  |  |  |  |  | 0，3343 | ＜ |
| 0 | Subject 15 | $>$ | 1，2987 |  |  |  |  |  | 0，2719 |  |  |  |  |  | 0，6034 |  | 0，397 |  |  |  | 0，5355 |  |  |  |  |  | 0，4122 | ＜ |
| P | Subject 16 | $>$ | 0，9658 |  |  |  |  |  | 0，3127 |  |  |  |  |  | 2，6908 |  |  |  |  |  | 0，8484 |  |  |  |  |  | 0，1548 | ＜ |
| Q | Subject 17 | $>$ | 1，0501 |  |  |  |  |  | 0，4972 |  |  |  |  |  | 0，8538 |  |  |  |  |  | 0，3753 |  |  |  |  |  | 0，8256 | ＜ |
| R | Subject 18 | $>$ | 0，6657 |  |  |  |  |  | 0，354 |  |  |  |  |  | 0，2544 |  |  |  |  |  | 0，1955 |  |  |  |  |  | 0，1629 | ＜ |


| Three syllables |  |  |  | Stimulus 159go．juu．kyuu |  |  |  |  | Stimulus 244yon．juu．yon |  |  |  |  |  | Stimulus 332san．juu．ni |  |  |  |  |  | $\begin{aligned} & \text { Stimulus } 4 \\ & \hline \text { しゅくだい } \\ & \text { shu.ku.da.i } \end{aligned}$ |  |  |  |  |  | Response time | Endclick |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start <br> click | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  | Response time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 1，3067 |  |  |  | 0，46 |  | 0，4706 |  |  |  |  |  | 0，406 |  | 0，894 |  | 0，204 |  | 1，0082 | NR |  |  |  |  | 0，6241 | ＜ |
| B | Subject 2 | $>$ | 1，5483 |  |  |  |  |  | 0，6844 |  |  |  |  |  | 0，59 |  |  |  |  |  | 2，1373 |  |  |  |  |  | 0，9192 | $<$ |
| C | Subject 3 | $>$ | 1，4343 |  |  |  | 1，348 |  | 1，3157 |  |  |  |  | NR | 1，121 |  |  |  |  |  | 0，4012 |  |  |  |  |  | 0，4548 | ＜ |
| D | Subject 4 | $>$ | 1，2444 |  |  |  |  |  | 0，5134 |  |  |  |  |  | 0，8945 |  |  |  |  |  | 1，0735 | R |  |  |  |  | －0，946 | ＜ |
| E | Subject 5 | $>$ | 1，5652 |  |  |  |  |  | 0 |  |  |  |  |  | 0，3182 |  |  |  |  |  | 0，194 |  |  |  |  |  | 0，0804 | ＜ |
| F | Subject 6 | $>$ | 2，771 |  |  |  |  |  | 0，7917 |  |  |  |  |  | 0，4436 |  |  |  |  |  | 0，5463 |  |  |  |  |  | 0 | $<$ |
| G | Subject 7 | $>$ | 6，992 |  |  |  |  |  | 2，0404 |  |  |  |  |  | 0，6718 |  |  |  |  |  | 2，6337 |  |  |  |  |  | 0，7316 | ＜ |
| H | Subject 8 | $>$ | 1，7286 |  |  |  |  |  | 0，3135 |  |  |  |  |  | 0，2382 |  |  |  |  |  | 0，3176 |  |  |  |  |  | 0，0567 | ＜ |
| 1 | Subject 9 | $>$ | 1，0375 |  |  |  |  |  | 0，2994 |  |  |  |  |  | 0，5071 |  |  |  |  |  | 0，3338 |  |  |  |  |  | 1，0623 | ＜ |
| J | Subject 10 | $>$ | 2，8352 |  |  |  |  |  | 1，0172 |  | 0，207 |  |  |  | 1，2341 |  |  |  |  |  | 1，4509 |  |  |  |  |  | 0，1609 | ＜ |
| K | Subject 11 | $>$ | 1，7315 |  |  |  |  |  | 0，6606 |  |  |  |  |  | 0，2269 |  |  |  | 0，742 |  | 0，5226 |  |  |  |  |  | 0，8859 | ＜ |
| L | Subject 12 | ＞ | 1，6421 |  |  |  | 0，408 |  | 0，5984 |  |  |  |  |  | 0，9472 |  |  |  |  |  | 0，5234 |  |  |  |  |  | 0，3558 | ＜ |
| M | Subject 13 | $>$ | 0，8839 |  |  |  |  |  | 0，1759 |  |  |  |  |  | 0，4883 |  |  |  |  |  | 0，1493 |  |  |  |  |  | －0，2018 | ＜ |
| N | Subject 14 | $>$ | 1，4553 |  |  |  |  |  | 1，3056 |  |  |  |  |  | 0，9112 |  |  |  |  |  | 1，4574 |  |  |  |  |  | 0，2025 | ＜ |
| 0 | Subject 15 | $>$ | 1，3325 |  |  |  | 0，437 |  | 0，5306 |  |  |  |  |  | 0，1659 |  |  |  | 0，238 |  | 0，6138 |  |  |  |  |  | －0，2015 | ＜ |
| P | Subject 16 | $>$ | 2，2562 |  |  |  |  |  | 0，2653 |  |  |  |  |  | 0，2435 |  |  |  |  |  | 0，5546 |  |  |  |  |  | 0，4602 | ＜ |
| Q | Subject 17 | ＞ | 1，5073 |  |  |  |  |  | 0，394 |  |  |  |  |  | 0，356 |  |  |  |  |  | 0，7077 |  |  |  |  |  | 0，7281 | ＜ |
| R | Subject 18 | $>$ | 0，8001 |  |  |  |  |  | 0，1227 |  |  |  |  |  | 0，2128 |  |  |  |  |  | 0，593 |  |  |  |  |  | 0，6345 | ＜ |




| Five syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { おくりもの } \\ \text { o.kur.i.mo.no } \end{gathered}$ |  |  |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus 2 } \\ \hline \text { 末ちあわせ } \\ \text { ma.chi.a.wa.se } \end{gathered}$ |  |  |  |  |  |  |  |  |  | Stimulus 3 hi．ru．ya．su．mi |  |  |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ \begin{array}{c} 71 \\ \text { na.na.ju.ichi } \end{array} \end{gathered}$ |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| ${ }^{\text {SN }}$ | Pseudonym | statt | Response |  |  |  |  | Reading |  |  |  |  | Response |  |  |  |  | Reading |  |  |  |  | Response |  |  |  |  | Reading |  |  |  |  | Response |  |  |  |  | Reading |  |  |  |  | Response | drs |
|  |  | click | time | s1 | Pause | s2 | Pause | 53 | Pause | 54 | Pause | 55 | time | s1 | Pause | 52 | Pause | 53 | Pause | 54 | Pause | 55 | time | s1 | Pause | s2 | Pause | 53 | Pause | 54 | Pause | 55 | time | s1 | Pause | S2 | Pause | 53 P | Pause | 54 | Pause | 55 | time |  |
| A | Subject 1 | $>$ | 1，8725 |  |  |  |  |  |  | NR |  |  | 0，6788 |  |  |  | 0，407 |  |  |  |  |  | 0，863 |  |  |  |  |  |  |  |  |  | 0，818 |  |  |  |  |  |  |  |  |  | 0，1868 | $<$ |
| B | Subject 2 | $>$ | 1，6463 |  |  |  |  |  |  |  |  |  | 0，7298 |  |  |  |  |  |  |  |  |  | 0，729 |  |  |  |  |  |  |  |  |  | 0，6418 |  |  |  |  |  |  |  |  |  | 0，5132 | $<$ |
| c | Subject 3 | $>$ | 1，3445 |  |  |  |  |  | 0，12 |  |  |  | 0，6701 |  |  |  | 0，74 |  |  |  |  |  | 2，9317 |  |  |  |  |  |  |  |  |  | 1，2566 |  |  |  |  |  |  |  |  |  | 0，0301 | $<$ |
| D | Suject 4 | $>$ | 1，2291 |  |  |  |  |  |  |  |  |  | 1，8008 |  |  |  |  |  |  |  |  |  | 0，3164 |  |  |  |  |  |  |  |  |  | 0，9784 |  |  |  |  |  |  |  |  |  | 0，3787 | ＜ |
| E | Subject 5 | $>$ | 1，2193 |  |  |  |  |  |  |  |  |  | 0 |  |  |  |  | NR | 0，17 |  |  |  | 0，2713 |  |  |  |  |  |  |  |  |  | 0，3199 |  |  |  |  |  |  |  |  |  | 0，0742 | $<$ |
| F | Subject 6 | $>$ | 3，8419 |  |  |  |  |  |  |  |  |  | 1，1686 |  |  |  |  |  |  |  |  |  | 1，4567 |  |  |  |  |  |  |  |  |  | 1，0411 |  |  |  |  |  |  |  |  |  | 0，1102 |  |
| 6 | Subject 7 | $>$ | 0，9699 |  |  |  |  |  |  |  |  |  | 0，9098 |  |  |  |  |  |  |  |  |  | 1，2417 |  |  |  |  |  |  |  |  |  | 2，2714 |  |  |  |  | R |  |  |  |  | 0，4185 | $<$ |
| H | Subject 8 | $>$ | 1，3663 |  |  |  |  |  |  |  |  |  | 1，1239 |  |  |  |  |  |  |  |  |  | 0，3636 |  |  |  |  |  |  |  |  |  | 0，5702 |  |  |  |  |  |  |  |  |  |  | $<$ |
| 1 | Subject 9 | $>$ | 1，3147 |  |  |  |  |  |  |  |  |  | 0，6007 |  |  |  |  |  |  |  |  |  | 0，4228 |  |  |  |  |  |  |  |  |  | 0，49618 |  |  |  |  |  |  |  |  |  | 0，5171 | $<$ |
| 1 | Subject 10 | $>$ | 1，7359 |  |  |  |  |  |  |  |  |  | 0，7944 |  |  |  |  |  |  |  | 0，173 |  | 0，8392 |  |  |  |  |  |  |  |  |  | 0，706 |  |  |  |  |  |  |  |  |  | 0，1993 | $<$ |
| K | subject 11 | $>$ | 1，5936 |  |  |  |  |  |  |  |  |  | 0，1888 |  |  |  |  |  | 0，176 |  |  |  | 0，6195 |  |  |  |  |  |  |  |  |  | 0，46 |  |  |  |  |  |  |  |  |  | 0，4241 | ＜ |
| L | subject 12 | $>$ | 1，9738 |  |  |  |  |  |  |  |  |  | 0，3748 |  |  |  |  |  |  |  |  |  | 0，5826 |  |  |  |  |  |  |  |  |  | 0，586 |  |  |  |  |  |  |  |  |  | $0<$ | $<$ |
| M | subject 13 | $>$ | 1，0704 |  |  |  |  |  |  |  |  |  | 0，0884 |  |  |  |  |  |  |  |  |  | 0，1521 |  |  |  |  |  |  |  |  |  | 0，5403 |  |  |  |  |  |  |  |  |  | 0，2367 | ＜ |
| N | subject 14 | $>$ | 4，77 |  | 0，832 |  |  |  |  |  |  |  | 1，0555 |  |  |  |  |  |  |  |  |  | 1，1742 |  |  |  | 0，369 |  |  |  |  |  | 0，8126 |  |  |  |  |  |  |  |  |  | 0，1379 | $<$ |
| － | Subject 15 | $>$ | 1，5657 |  |  |  |  |  |  |  |  |  | 0，9373 |  |  |  |  |  |  |  |  |  | 1，0397 |  |  |  |  |  |  |  |  |  | 4，8567 |  |  |  |  |  | 0，267 |  |  |  |  | $<$ |
| P | subject 16 | $>$ | 2，5795 |  |  |  |  |  |  |  |  |  | 0，5769 |  |  |  |  |  |  |  |  |  | 1，8618 |  |  |  |  |  |  | NR |  |  | 0，8408 |  |  |  |  |  |  |  |  |  | 0，326 | $<$ |
| Q | Subject 17 | $>$ | 1，0294 |  |  |  |  |  |  |  |  |  | 1，134 |  |  |  |  |  |  |  |  |  | 0，9353 |  |  |  |  |  |  |  |  |  | 0，7622 |  |  |  |  |  |  |  |  |  | 0，4632 $<$ | $<$ |
| ， | subject 18 | $>$ | 1，4449 |  |  |  |  |  |  |  |  |  | 0，5316 |  |  |  |  |  |  |  |  |  | 0，6868 |  |  |  |  |  |  |  |  |  | 0，7101 |  |  |  |  |  |  |  |  |  | 0，3051＜ | $<$ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { げつようび } \end{gathered}$ <br> ge．tsu．you．bi |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 2 \\ \hline \text { でんわばんごう } \\ \text { den.wa.ban.gou } \end{gathered}$ |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 3 \\ \hline \text { たてもの } \\ \text { ta.te.mo.no } \end{gathered}$ |  |  |  |  |  |  | Stimulus 4 28 <br> ni．juu．ha．chi |  |  |  |  |  |  |  | Response <br> time |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| SN | Pseudonym | Start | Response | Reading |  |  |  |  |  |  | Response | Reading |  |  |  |  |  |  | Response | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  |  |  |
|  |  | click | time | S1 | Pause | S2 | Pause | 53 | Pause | S4 | time | S1 | Pause | S2 | Pause | 53 | Pause | 54 | time | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | S3 | Pause | 54 |  |  |
| A | Subject 1 | $>$ | 1，62 |  |  | NR |  |  |  |  | 0，8527 |  |  |  |  |  |  |  | 0，361 |  |  |  |  |  |  |  | 0，4677 |  | 0，79 |  | 0，11 |  |  |  | 0，1353 | ＜ |
| B | Subject 2 | ＞ | 1，4009 |  |  |  |  |  |  |  | 0，5643 |  |  |  |  |  |  |  | 0，8844 |  |  |  |  |  |  |  | 0，7821 |  |  |  |  |  |  |  | 0，9828 | ＜ |
| c | Subject 3 | $>$ | 3，2067 |  |  |  |  |  |  |  | 0，7424 |  |  |  |  |  |  |  | 1，09 |  |  |  |  |  |  |  | 0，6792 |  |  |  | 0，886 |  |  |  | 1，456 | ＜ |
| D | Subject 4 | $>$ | 1，748 |  |  |  |  |  |  |  | 0，4329 |  |  |  |  |  |  |  | 0，4903 |  |  |  |  |  |  |  | 0，6099 |  |  |  | 0，47 |  |  |  | 0 | $<$ |
| E | Subject 5 | $>$ | 1，5584 |  |  |  |  |  |  |  | 0，6107 |  |  |  |  |  |  |  | 0，2285 |  |  |  |  |  |  |  | 0，0808 |  |  |  |  |  |  |  | 0，0968 | ＜ |
| F | Subject 6 | $>$ | 2，7821 |  |  |  |  |  |  |  | 1，6241 |  |  |  |  |  |  |  | 0，7827 |  |  |  |  |  |  |  | 0，6322 |  |  |  |  |  |  |  | 0，1704 | ＜ |
| G | Subject 7 | $>$ | 2，6388 |  |  |  |  |  |  |  | 0，9643 |  |  |  |  |  |  |  | 1，2055 |  |  |  |  |  |  |  | 0，2799 |  |  |  |  |  |  |  | 0 | ＜ |
| H | Subject 8 | $>$ | 1，6019 |  |  |  |  |  |  |  | 0，2084 |  |  |  |  |  |  |  | 0，1515 |  |  |  |  |  |  |  | 0，3924 |  |  |  |  |  |  |  | 0，2546 | ＜ |
| 1 | Subject 9 | $>$ | 1，2087 |  |  |  |  |  |  |  | 0，9662 |  |  |  |  |  |  |  | 0，6384 |  |  |  |  |  |  |  | 0，6099 |  |  |  |  |  |  |  | 0，464 | ＜ |
| J | Subject 10 | $>$ | 2，1477 | NR |  |  |  |  |  |  | 2，5288 |  |  |  |  |  |  |  | 1，8817 |  |  |  |  |  |  |  | 0，7032 |  | 0，267 |  |  |  |  |  | 0，2645 | ＜ |
| K | Subject 11 | $>$ | 1，9832 |  |  |  |  |  |  |  | 0，3779 |  |  |  |  |  |  |  | 0，3742 |  |  |  |  |  |  |  | 0，0953 |  |  |  |  |  |  |  | 0，5961 | ＜ |
| L | Subject 12 | $>$ | 1，6943 |  |  |  |  |  |  |  | 0，7383 |  |  |  |  |  |  |  | 0，3562 |  |  |  |  |  |  |  | 1，019 |  |  |  |  |  |  |  | 0 | ＜ |
| M | Subject 13 | $>$ | 1，2579 |  |  |  |  |  |  |  | 0，1084 |  |  |  |  |  |  |  | 0，0849 |  |  |  |  |  |  |  | 0，6936 |  |  |  |  |  |  |  | 0，4354 | ＜ |
| N | Subject 14 | $>$ | 2，2761 |  |  |  |  |  |  |  | 1，7868 |  |  |  |  |  |  |  | 1，602 |  |  | NR |  |  |  |  | 1，5898 |  |  |  |  |  |  |  | 0，8769 | ＜ |
| 0 | Subject 15 | $>$ | 2，1306 | NR |  |  |  |  | 0，179 |  | 1，0813 |  |  |  | 0，616 |  |  |  | 0，5153 |  |  |  |  |  |  |  | 0，2517 |  |  |  |  |  |  |  | 0，1959 | ＜ |
| P | Subject 16 | $>$ | 1，4528 |  |  |  |  |  |  |  | 0，6997 |  |  |  |  |  |  |  | 1，0758 |  |  |  |  |  |  |  | 0，5198 |  |  |  |  |  |  |  | 0，3154 | ＜ |
| Q | Subject 17 | $>$ | 0，967 |  |  |  |  |  |  |  | 0，9282 |  |  |  |  |  |  |  | 0，5611 |  |  |  |  |  |  |  | 0，7333 |  |  |  |  |  |  |  | 0，54 | ＜ |
| R | Subject 18 | $>$ | 1，4657 |  |  |  |  |  |  |  | 0，7079 |  |  |  |  |  |  |  | 0，5098 |  |  |  |  |  |  |  | 0，3965 |  |  |  |  |  |  |  | 0，0645 | ＜ |


| Four syllables |  |  |  | $\begin{aligned} & \text { Stimulus } 1 \\ & \text { どうぶつえん } \\ & \text { dou.bu.tsu.en } \end{aligned}$ |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus 2 } \\ \hline \text { かいがいりょこう } \\ \text { kai.gai.ryo.kou } \end{gathered}$ |  |  |  |  |  |  | Stimulus 3 shi．a．wa．se |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ \hline 57 \\ \text { go.juu.na.na } \end{gathered}$ |  |  |  |  |  |  |  | Response <br> time | End |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | $\begin{array}{\|l\|} \hline \text { Start } \\ \text { click } \\ \hline \end{array}$ | Response time |  |  |  |  |  |  |  | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  | Response time | Reading |  |  |  |  |  |  | Response <br> time |  |  | Reading |  |  |  |  |  |  |
| sN |  |  |  | S1 | Pause | 52 | Pause | 53 | Pause | 54 | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | S4 |  |  |  |
| A | Subject 1 | $>$ | 1，8416 |  |  |  |  |  |  |  | 0，7903 |  |  |  |  |  |  | NR | 0，4379 |  |  |  |  |  |  |  | 2，4016 |  |  |  | 0，327 |  |  |  | 0，5311 | $<$ |
| B | Subject 2 | $>$ | 1，0715 |  |  |  |  |  |  |  | 1，0012 |  |  |  |  |  |  |  | 0，6425 |  |  |  |  |  |  |  | 0，8337 |  |  |  |  |  |  |  | 0，9517 | $<$ |
| c | Subject 3 | $>$ | 1，8825 |  |  |  |  |  |  |  | 1，1851 |  |  |  |  |  | 0，51 |  | 1，3872 |  |  |  |  |  |  |  | 1，2152 |  |  |  |  |  |  |  | 0，882 | $<$ |
| D | Subject 4 | $>$ | 1，7643 |  |  |  |  |  |  |  | 0，2001 |  |  |  |  |  |  | NR | 2，0681 |  |  |  |  |  |  |  | 3，0548 |  |  |  |  |  |  |  | 0，0433 | $<$ |
| E | Subject 5 | $>$ | 1，1846 |  |  |  |  |  |  |  | 0，1933 |  |  |  |  |  |  |  | 0，2692 |  |  |  |  |  |  |  | 0，1692 |  |  |  |  |  |  |  | 0，3758 | ＜ |
| F | Subject 6 | $>$ | 2，0734 |  |  |  |  |  |  |  | 5，1837 |  |  |  |  |  |  |  | 1，7279 |  |  |  |  |  |  |  | 1，4511 |  |  |  |  |  |  |  | 0，3706 | $<$ |
| G | Subject 7 | $>$ | 2，2981 |  |  |  |  |  |  |  | 1，0482 |  |  |  |  |  |  |  | 0，8744 |  |  |  |  |  |  |  | 2，7684 |  |  |  | 0，334 |  |  |  | 0，2798 | ＜ |
| H | Subject 8 | $>$ | 1，3869 |  |  |  | 0，23 |  |  |  | 1，1216 |  |  |  |  |  |  |  | 0，1267 |  |  |  |  |  |  |  | 0，5657 |  |  |  |  |  |  |  | 0，0722 | $<$ |
| 1 | Subject 9 | $>$ | 2，0285 |  |  |  |  |  |  |  | 0，9571 |  |  |  |  | R | 0，338 |  | 0，4416 |  |  |  |  |  |  |  | 0，6811 |  |  |  |  |  |  |  | 0，4933 | ＜ |
| J | Subject 10 | $>$ | 1，4686 |  |  |  |  |  |  |  | 3，4555 |  |  |  |  |  |  |  | 1，7796 |  |  |  |  |  |  |  | 1，9005 |  |  |  |  |  |  |  |  | $<$ |
| K | Subject 11 | $>$ | 1，2113 |  |  |  |  |  |  |  | 0，1743 |  |  |  | 0，178 |  |  |  | 0，5088 |  |  |  |  |  |  |  | 0，6228 |  |  |  |  |  |  |  |  | $<$ |
| L | Subject 12 | $>$ | 1，2267 |  |  |  |  |  |  |  | 0，4994 |  |  |  |  |  |  |  | 0，4163 |  |  |  |  |  |  |  | 0，798 |  |  |  |  |  |  |  | 0，0722 | ＜ |
| M | Subject 13 | $>$ | 1，3291 |  |  |  |  |  |  |  | 0，1129 |  |  |  |  |  |  |  | 0，5429 |  |  |  |  |  |  |  | 0，4052 |  |  |  |  |  |  |  |  | $<$ |
| N | Subject 14 | $>$ | 2，4047 |  |  |  |  |  |  |  | 0，8002 |  |  |  | 0，28 |  |  |  | 1，4672 |  |  |  |  |  |  |  | 1，0871 |  |  |  |  |  |  |  | 0，4135 | ＜ |
| 0 | Subject 15 | $>$ | 1，9662 |  |  |  |  |  |  |  | 0，9514 |  | 0，778 | NR |  |  |  |  | 0，849 |  |  |  |  |  |  |  | 0，1539 |  |  |  | 0，456 |  |  |  | 0，0981 | $<$ |
| P | Subject 16 | $>$ | 1，508 |  |  |  |  |  |  |  | 0，8129 |  |  |  |  |  |  |  | 1，0956 |  |  |  |  |  |  |  | 1，0956 |  |  |  |  |  |  |  | 0，5147 | $<$ |
| Q | Subject 17 | $>$ | 1，4657 |  |  |  |  |  |  |  | 1，215 |  |  |  |  |  |  |  | 0，5951 |  |  |  |  |  |  |  | 0，7921 |  |  |  |  |  |  |  | 0，5481 | ＜ |
| R | Subject 18 | $>$ | 1，9748 |  |  |  |  |  |  |  | 1，4034 |  |  |  |  |  |  |  | 1，3203 |  |  |  |  |  |  |  | 0，0963 |  |  |  |  |  |  |  | 0，0838 | ＜ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \text { ともだち } \\ \text { to.mo.da.chi } \end{gathered}$ |  |  |  |  |  |  | $\frac{\text { Stimulus } 2}{\text { うけつけ }}$ <br> u．ke．tsu．ke |  |  |  |  |  |  |  | Stimulus 3 せんたくき sen．ta．ku．ki |  |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ \hline 83 \\ \text { ha.chi.juu.san } \end{gathered}$ |  |  |  |  |  |  |  | Response <br> time | （End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start | Response | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  |  |  |
|  | Pseud | click | time | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |
| A | Subject 1 | $>$ | 1，3372 |  |  |  |  |  |  |  | 0，4429 |  |  |  |  |  |  |  | 1，4357 |  |  |  |  |  |  |  | 4，8546 |  |  |  |  |  |  |  | 0，3552 | ＜ |
| B | Subject 2 | ＞ | 1，0827 |  |  |  |  |  |  |  | 0，51 |  |  |  |  |  |  |  | 0，4797 |  |  |  |  |  |  |  | 0，9583 |  |  |  |  |  |  |  | 0，9653 | ＜ |
| c | Subject 3 | $>$ | 1，4538 |  |  |  |  |  |  |  | 0，1992 |  |  |  |  |  |  |  | 1，413 |  |  |  | 1，217 |  |  |  | 0，9703 |  |  |  |  |  |  |  | 0，3825 | $<$ |
| D | Subject 4 | $>$ | 1，3313 |  |  |  |  |  |  |  | 0，1815 |  |  |  |  |  |  |  | 2，665 |  |  |  |  |  |  |  | 2，535 |  |  |  |  |  | 0，258 |  | －0，2378 | $<$ |
| E | Subject 5 | $>$ | 1，3408 |  |  |  |  |  |  |  | 0，0806 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 1，361 |  |  |  |  |  |  |  | 0，1829 | ＜ |
| F | Subject 6 | $>$ | 1，3961 |  |  |  |  |  |  |  | 0，3793 |  |  |  |  |  |  |  | 6，5855 |  |  |  |  |  |  |  | 2，82 |  |  |  |  |  |  |  | 0，4497 | $<$ |
| G | Subject 7 | $>$ | 1，7134 |  |  |  |  |  |  |  | 0，1041 |  |  |  |  |  |  |  | 0，4818 |  |  |  |  |  |  |  | 1，2491 |  |  |  |  |  |  |  | 0，3062 | $<$ |
| H | Subject 8 | $>$ | 0，9282 |  |  |  |  |  |  |  | 0，2002 |  |  |  |  |  |  |  | 1，2759 |  |  |  |  |  |  |  | 0，664 |  |  |  |  |  |  |  | 0 | $<$ |
| 1 | Subject 9 | ＞ | 1，6413 |  |  |  |  |  |  |  | 0，4918 |  |  |  |  |  |  |  | 0，4913 |  |  |  |  |  |  |  | 0，4921 |  |  |  |  |  |  |  | 0，4914 | $<$ |
| J | Subject 10 | $>$ | 1，9343 |  |  |  |  |  |  |  | 0，5695 |  |  |  |  |  |  |  | 1，07 |  |  |  |  |  |  |  | 0，9132 |  |  |  |  |  |  |  | 0，0622 | $<$ |
| K | Subject 11 | $>$ | 1，3596 |  |  |  |  |  |  |  | 0，2781 | NR |  |  |  |  |  |  | 0，806 |  |  |  |  |  |  |  | 0，3604 |  |  |  |  |  | 0，351 |  | 1，1578 | $<$ |
| L | Subject 12 | $>$ | 1，0854 |  |  |  |  |  |  |  | 0，4688 |  |  |  |  |  |  |  | 0，4163 |  |  |  |  |  |  |  | 1，3335 |  |  |  |  |  |  |  | 0，0671 | $<$ |
| M | Subject 13 | $>$ | 1，1272 |  |  |  |  |  |  |  | 0，0652 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 0，5514 |  |  |  |  |  |  |  | －0，2035 | $<$ |
| N | Subject 14 | ＞ | 1，8294 |  |  |  |  |  |  |  | 1，5733 |  |  |  |  |  | 0，25 |  | 3，7153 |  |  |  |  |  |  |  | 1，8119 |  |  |  |  |  |  |  | －0，1841 | ＜ |
| － | Subject 15 | $>$ | 1，0088 |  |  |  |  |  |  |  | 0，1201 |  |  |  |  |  |  |  | 2，5449 |  |  |  |  |  |  |  | 2，6098 |  |  |  |  |  |  |  | 0，175 | $<$ |
| P | Subject 16 | $>$ | 1，7094 |  |  |  |  |  |  |  | 0，9065 |  |  |  |  |  |  |  | 0，8542 |  |  |  |  |  |  |  | 0，7416 |  |  |  |  |  |  |  | 0，1968 | $<$ |
| Q | Subject 17 | $>$ | 1，2683 |  |  |  |  |  |  |  | 0，6695 |  |  |  |  |  |  |  | 0，5524 |  |  |  |  |  | 0，294 |  | 1，1609 |  |  |  |  |  |  |  | 0，5919 | ＜ |
| R | Subject 18 | $>$ | 1，2268 |  |  |  |  |  |  |  | 0，4475 |  |  |  |  |  |  |  | 0，4278 |  |  |  |  |  | 0，615 |  | 1，3826 |  |  |  |  |  |  |  | 0，3413 | ＜ |


| Four syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { だいがくせい } \\ \text { dai.ga.ku.sei } \end{gathered}$ |  |  |  |  |  |  | $\begin{gathered} \text { Stimulus 2 } \\ \begin{array}{c} \text { のみもの } \\ \text { no.mi.mo.no } \end{array} \end{gathered}$ |  |  |  |  |  |  |  | $\begin{aligned} & \text { Stimulus } 3 \\ & \begin{array}{l} \text { かみなり } \\ \text { ka.mi.na.ri } \end{array} \\ & \hline \end{aligned}$ |  |  |  |  |  |  |  | Stimulus 464ro．ku．juu．yon |  |  |  |  |  |  |  | Response <br> time | End |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start | Response <br> time | Reading |  |  |  |  |  |  | Response time | Reading |  |  |  |  |  |  | Response time | Reading |  |  |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  |  |  |
|  |  | click |  | S1 | Pause | 52 | Pause | 53 | Pause | S4 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  | S1 | Pause | S2 | Pause | 53 | Pause | 54 |  |  |
| A | Subject 1 | $>$ | 1，2583 |  |  |  |  |  |  |  | 0，3968 |  |  |  |  |  |  |  | 0，3767 |  |  |  |  |  |  |  | 1，217 |  |  |  |  |  |  |  | 0，4059 | ＜ |
| B | Subject 2 | $>$ | 1，5239 |  |  |  |  |  |  |  | 0，5168 |  |  |  |  |  |  |  | 0，5411 |  |  |  |  |  |  |  | 1，1549 |  |  |  |  |  |  |  | 0，9563 | ＜ |
| c | Subject 3 | $>$ | 1，6731 |  |  | NR |  | NR |  |  | 0，915 |  |  |  |  |  |  |  | 1，1503 |  |  |  |  |  |  |  | 0，4052 |  |  |  |  |  |  | NR | 0，5211 | ＜ |
| D | Subject 4 | $>$ | 2，0925 |  |  |  |  |  |  |  | 0，7914 |  |  |  |  |  |  |  | 1，5821 |  |  |  |  |  |  |  | 0，7155 |  |  |  |  |  |  |  | －0，1519 | $<$ |
| E | Subject 5 | $>$ | 1，1812 |  |  |  |  |  |  |  | 0，2091 |  |  |  |  |  |  |  | 0，0549 |  |  |  |  |  |  |  | 0，2314 |  |  |  |  |  | 0，506 |  | 0，3405 | ＜ |
| F | Subject 6 | $>$ | 2，1418 |  |  |  |  |  |  |  | 1，5035 |  |  |  |  |  |  |  | 1，2623 |  |  |  |  |  |  |  | 0，8658 |  |  |  |  |  |  |  | 0，2586 | $<$ |
| G | Subject 7 | $>$ | 1，3192 |  |  |  |  |  |  |  | 0，6077 |  |  |  |  |  |  |  | 0，7128 |  |  |  |  |  |  |  | 0，63 |  |  |  |  |  |  |  | 0，0897 | $<$ |
| H | Subject 8 | $>$ | 1，3028 |  |  |  |  |  |  |  | 0，4962 |  |  |  |  |  |  |  | 0，3889 |  |  |  |  |  |  |  | 0，6528 |  |  |  |  |  |  |  | 0 | $<$ |
| 1 | Subject 9 | $>$ | 1，2067 |  |  |  |  |  |  |  | 0，8098 |  |  |  |  |  |  |  | 0，7129 |  |  |  |  |  |  |  | 0，9171 |  |  |  |  |  |  |  | 0，5316 | ＜ |
| J | Subject 10 | $>$ | 2，1759 |  |  |  |  |  |  |  | 0，5863 |  |  |  |  |  |  |  | 0，4184 |  |  |  |  |  |  |  | 1，4125 |  |  |  |  |  |  |  | 0，9623 | ＜ |
| K | Subject 11 | $>$ | 1，3086 |  |  |  |  |  |  |  | 0，1478 |  |  |  |  |  |  |  | 0，3509 |  |  |  |  |  |  |  | 0，8468 |  |  |  |  |  |  |  | 0，292 | $<$ |
| L | Subject 12 | $>$ | 1，4345 |  |  |  |  |  |  |  | 0，3761 |  |  |  |  |  |  |  | 0，3537 |  |  |  |  |  |  |  | 0，5826 |  |  |  |  |  |  |  | 0，2307 | $<$ |
| M | Subject 13 | $>$ | 1，0424 |  |  |  |  |  |  |  | 0 |  |  |  |  |  |  |  | 0，0924 |  |  |  |  |  |  |  | 1，5658 |  |  |  |  |  |  |  | 0，1154 | ＜ |
| N | Subject 14 | $>$ | 1，8605 |  |  |  |  |  |  |  | 1，429 |  |  |  |  |  |  |  | 1，4466 |  |  |  |  |  |  |  | 1，0235 |  |  |  |  |  |  |  | 0，5631 | $<$ |
| 0 | Subject 15 | $>$ | 1，6957 |  |  |  |  |  |  |  | 0，3717 |  |  |  |  |  |  |  | 0，5829 |  |  |  |  |  |  |  | 0，9795 |  |  |  |  |  | 0，645 |  | 0，1778 | $<$ |
| P | Subject 16 | $>$ | 1，3017 |  |  |  |  |  |  |  | 0，8601 |  |  |  |  |  |  |  | 1，662 |  |  |  |  |  |  |  | 0，6625 |  |  |  |  |  |  |  | 0，1771 | ＜ |
| Q | Subject 17 | $>$ | 1，4242 |  |  |  |  |  |  |  | 0，2792 |  |  |  |  |  |  |  | 0，7358 |  |  |  |  |  |  |  | 0，7601 |  |  |  |  |  | 0，389 | R | 0，5412 | ＜ |
| R | Subject 18 | $>$ | 1，8086 |  |  |  |  |  |  |  | 0，3269 |  |  |  |  |  |  |  | 0，6657 |  |  |  |  |  |  |  | 0，0769 |  |  |  |  |  |  |  | 0，3436 | ＜ |


| Three syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { くるま } \\ \text { ku.ru.ma } \end{gathered}$ |  |  |  |  | $\begin{gathered} \text { Stimulus } 2 \\ \hline \text { あたま } \\ \text { a.ta.ma } \end{gathered}$ |  |  |  |  |  | Stimulus 3うしろu．shi．ro |  |  |  |  |  | Stimulus 4 95 <br> kyuu．juu．go |  |  |  |  |  | Response <br> time | End click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | $\begin{array}{\|c\|} \hline \text { Start } \\ \text { click } \\ \hline \end{array}$ | Response <br> time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S 1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 1，8757 |  |  |  |  |  | 0，2793 |  |  |  |  |  | 1，1700 |  |  |  |  |  | 3，178 |  |  |  |  |  | 1，9499 | ＜ |
| B | Subject 2 | $>$ | 1，1859 |  |  |  |  |  | 0，949 |  |  |  |  |  | 0，958 |  |  |  |  |  | 1，0935 |  |  |  |  |  | 0，8836 | ＜ |
| C | Subject 3 | $>$ | 1，4001 |  |  |  |  |  | 0，2154 |  |  |  |  |  | 0，3519 |  |  |  |  |  | 1，1168 |  |  |  | 0，148 |  | 0，1585 | ＜ |
| D | Subject 4 | $>$ | 1，2394 |  |  |  |  |  | 1，6245 |  |  |  |  |  | 1，6847 |  |  |  |  |  | 1，107 |  |  |  |  |  | 0 | ＜ |
| E | Subject 5 | $>$ | 1，5075 |  |  |  |  |  | 0，1032 |  |  |  |  |  | 0，779 |  |  |  |  |  | 0，3717 |  |  |  | 0，328 |  | 0，2473 | ＜ |
| F | Subject 6 | $>$ | 1，667 |  |  |  |  |  | 0，5699 |  |  |  |  |  | 0，6611 |  |  |  |  |  | 1，7859 |  |  |  |  |  | 0，6623 | ＜ |
| G | Subject 7 | $>$ | 2，6622 |  |  |  |  |  | 0，5538 |  |  |  |  |  | 0，7098 |  |  |  |  |  | 2，0591 | NR |  |  |  |  | 0，3226 | ＜ |
| H | Subject 8 | $>$ | 0，8947 |  |  |  |  |  | 0，2616 |  |  |  |  |  | 0，4388 |  |  |  |  |  | 0，832 |  |  |  |  |  | 0，1862 | ＜ |
| 1 | Subject 9 | $>$ | 0，9479 |  |  |  |  |  | 0，5917 |  |  |  |  |  | 0，58 |  |  |  |  |  | 0，8364 |  |  |  |  |  | 0，7695 | ＜ |
| J | Subject 10 | $>$ | 1，9514 |  |  |  |  |  | 0，2801 |  |  |  |  |  | 1，318 |  |  |  |  |  | 1，285 |  |  |  |  |  | 1，0302 | ＜ |
| K | Subject 11 | $>$ | 0，8118 |  |  |  |  |  | 0，6782 |  |  |  |  |  | 0，5893 |  |  |  |  |  | 3，0028 |  |  |  |  |  | 0，5965 | ＜ |
| L | Subject 12 | $>$ | 1，1148 |  |  |  |  |  | 0，5158 |  |  |  |  |  | 0，4452 |  |  |  |  |  | 0，5511 |  |  |  |  |  | －0，1392 | ＜ |
| M | Subject 13 | $>$ | 0，8963 |  |  |  |  |  | 0，1098 |  |  |  |  |  | 0，237 |  |  |  |  |  | 0，5998 |  |  |  |  |  | 0，4846 | ＜ |
| N | Subject 14 | $>$ | 3，4813 |  |  |  |  |  | 0，6294 |  |  |  |  |  | 1，3571 |  |  |  |  |  | 0，7882 |  |  |  |  |  | 1，0486 | ＜ |
| 0 | Subject 15 | $>$ | 1，2683 |  |  |  |  |  | 0，3119 |  |  |  |  |  | 0，593 |  |  |  |  |  | 0，1872 |  |  |  |  |  | 0，3572 | ＜ |
| P | Subject 16 | $>$ | 1，6617 |  |  |  |  |  | 0，7075 |  |  |  |  |  | 0，8196 |  |  |  |  |  | 1，3025 |  |  |  |  |  | 0，2805 | ＜ |
| Q | Subject 17 | $>$ | 1，154 |  |  |  |  |  | 0，4298 |  |  |  |  |  | 0，4298 |  |  |  |  |  | 0，6094 |  |  |  |  |  | 0，387 | ＜ |
| R | Subject 18 | ＞ | 1，1748 |  |  |  |  |  | 0，355 |  |  |  |  |  | 0，4939 |  |  |  |  |  | 1，0994 |  |  |  |  |  | 0，2085 | ＜ |


| Three syllables |  |  |  | $\begin{gathered} \text { Stimulus } 1 \\ \hline \text { ところ } \\ \text { to.ko.ro } \end{gathered}$ |  |  |  |  | $\begin{gathered} \text { Stimulus } 2 \\ \hline \text { ねずみ } \\ \text { ne.zu.mi } \end{gathered}$ |  |  |  |  |  | $\frac{\text { Stimulus } 3}{\partial<\hbar}$tsu.ku.e |  |  |  |  |  | $\begin{gathered} \text { Stimulus } 4 \\ 42 \\ \text { yon.juu.ni } \end{gathered}$ |  |  |  |  |  | Response time | End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start <br> click | Response time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Responsetime | Reading |  |  |  |  | Response time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 1，7151 |  |  |  |  |  | 0，3956 |  |  |  |  |  | 0，3028 |  |  |  |  |  | 0，5972 |  |  |  | 0，551 |  | 1，2060 | ＜ |
| B | Subject 2 | $>$ | 1，5815 |  |  |  |  |  | 0，8399 |  |  |  |  |  | 0，482 |  |  |  |  |  | 0，4877 |  |  |  |  |  | 0，2705 | ＜ |
| C | Subject 3 | $>$ | 1，8503 |  |  |  |  |  | 1，5859 |  |  |  |  |  | 0，5991 |  |  |  |  |  | 0，5024 |  |  |  |  |  | 0，4595 | ＜ |
| D | Subject 4 | $>$ | 1，8569 |  |  |  |  |  | 0，1833 |  |  |  |  |  | 0，4791 |  |  |  |  |  | 0，5431 |  |  |  |  |  | 0 | ＜ |
| E | Subject 5 | $>$ | 1，2449 |  |  |  |  |  | 0，2274 |  |  |  |  |  | 0，2026 |  |  |  |  |  | 0 |  |  |  |  |  | 0，5201 | ＜ |
| F | Subject 6 | $>$ | 1，8621 |  |  |  |  |  | 1，2914 |  |  |  |  |  | 1，2164 |  |  |  |  |  | 0，7965 |  |  |  | 1，066 |  | 0，6316 | ＜ |
| G | Subject 7 | $>$ | 2，4301 |  |  |  |  |  | 0，9166 |  |  |  |  |  | 1，1253 |  |  |  |  |  | 0，3982 |  |  |  |  |  | 0，4238 | ＜ |
| H | Subject 8 | $>$ | 0，8247 |  |  |  |  |  | 0，8186 |  |  |  |  |  | 0，0898 |  |  |  |  |  | 0，1268 |  |  |  |  |  | 0，1223 | ＜ |
| 1 | Subject 9 | $>$ | 1，1313 |  |  |  |  |  | 0，6309 |  |  |  |  |  | 0，8965 |  |  |  |  |  | 0，5985 |  |  |  |  |  | 0，6728 | ＜ |
| J | Subject 10 | $>$ | 0，9424 |  |  |  |  |  | 0，7879 |  |  |  |  |  | 0，6533 |  |  | NR |  |  | 1，2883 |  |  |  |  |  | 0，4362 | ＜ |
| K | Subject 11 | $>$ | 1，7327 |  |  |  |  |  | 0，183 |  |  |  |  |  | 0，1929 |  |  |  |  |  | 0，5521 |  | 0，271 |  |  |  | 0 | ＜ |
| L | Subject 12 | $>$ | 0，9255 |  |  |  |  |  | 0，7281 |  |  |  |  |  | 0，6034 |  |  |  |  |  | 0，6433 |  |  |  |  |  | 0，0676 | ＜ |
| M | Subject 13 | $>$ | 0，8899 |  |  |  |  |  | 0 |  |  |  |  |  | 1，1297 |  |  |  |  |  | 0，315 |  |  |  |  |  | 0，3215 | ＜ |
| N | Subject 14 | $>$ | 1，5904 |  |  |  |  |  | 1，3519 |  |  |  |  |  | 1，1569 |  |  |  |  |  | 1，1439 |  |  |  |  |  | 0，2485 | ＜ |
| 0 | Subject 15 | $>$ | 0，9845 |  |  |  |  |  | 0，5873 |  |  |  |  |  | 0，8889 |  |  |  |  |  | 0，4148 |  |  |  |  |  | 0 | ＜ |
| P | Subject 16 | $>$ | 1，3676 |  |  |  |  |  | 0，6305 |  |  |  |  |  | 0，3647 |  |  |  |  |  | 0，3155 |  |  |  |  |  | 0，0296 | ＜ |
| Q | Subject 17 | $>$ | 1，2475 |  |  |  |  |  | 0，8191 |  |  |  |  |  | 0，7333 |  |  |  |  |  | 0，8476 |  |  |  |  |  | 0，4342 | ＜ |
| R | Subject 18 | $>$ | 2，0579 |  |  |  |  |  | 0，3364 |  |  |  |  |  | 0，8216 |  |  |  |  |  | 0，3365 |  |  |  |  |  | 0，5065 | ＜ |


| Three syllables |  |  |  | Stimulus 1 おんがく on．ga．ku |  |  |  |  | $\begin{gathered} \text { Stimulus } 2 \\ \hline \text { てがみ } \\ \text { te.ga.mi } \end{gathered}$ |  |  |  |  |  | $\begin{aligned} & \text { Stimulus } 3 \\ & \hline \text { ゆうがた } \\ & \text { yuu.ga.ta } \end{aligned}$ |  |  |  |  |  | $\begin{gathered} \frac{\text { Stimulus } 4}{16} \\ \text { juu.ro.ku } \end{gathered}$ |  |  |  |  |  | Response time | End <br> click |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| SN | Pseudonym | Start <br> click | Response time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  | Response time | Reading |  |  |  |  | Response <br> time | Reading |  |  |  |  |  |  |
|  |  |  |  | S1 | Pause | S2 | Pause | S3 |  | S 1 | Pause | S2 | Pause | S3 |  | S 1 | Pause | S2 | Pause | S3 |  | S1 | Pause | S2 | Pause | S3 |  |  |
| A | Subject 1 | $>$ | 0，9577 |  |  |  |  |  | 0，333 |  |  |  |  |  | 0，3852 |  |  |  |  |  | 0，3375 |  |  |  |  |  | 0，5015 | ＜ |
| B | Subject 2 | $>$ | 1，396 |  |  |  |  |  | 0，7529 |  |  |  |  |  | 0，7661 |  |  |  |  |  | 0，9149 |  |  |  |  |  | 0，5267 | ＜ |
| C | Subject 3 | $>$ | 1，2327 |  |  |  |  |  | 0，2675 |  |  |  |  |  | 0，8156 |  | 0，524 | NR |  |  | 1，0836 |  |  |  |  |  | 0，2633 | ＜ |
| D | Subject 4 | $>$ | 1，7487 |  |  |  |  |  | 0，6874 |  |  |  |  |  | 0，7438 |  |  |  |  |  | 0，6977 |  |  |  |  |  | 0 | $<$ |
| E | Subject 5 | $>$ | 1，3088 |  |  |  |  |  | 0，045 |  |  |  |  |  | 0，0982 |  |  |  |  |  | 0，3818 |  |  |  |  |  | 0，1528 | ＜ |
| F | Subject 6 | $>$ | 1，3459 |  |  |  |  |  | 0，7239 |  |  |  |  |  | 1，2133 |  |  |  |  |  | 1，509 |  |  |  |  |  | 0，171 | ＜ |
| G | Subject 7 | $>$ | 1，3038 |  |  |  |  |  | 0，1525 |  |  |  |  |  | 0，5078 |  |  |  |  |  | 1，8832 |  |  |  |  |  | 0，4245 | ＜ |
| H | Subject 8 | $>$ | 0，965 |  |  |  |  |  | 0，1833 |  |  |  |  |  | 0，3505 |  |  |  |  |  | 1，1848 |  |  |  |  |  | 0，2767 | ＜ |
| I | Subject 9 | $>$ | 1，0075 |  |  |  |  |  | 0，4936 |  |  |  |  |  | 0，4414 |  |  |  |  |  | 0，651 |  |  |  |  |  | 0，7241 | ＜ |
| J | Subject 10 | $>$ | 1，9463 |  |  |  |  |  | 0，2128 |  |  |  |  |  | 0，3031 |  |  |  |  |  | 1，2607 |  |  |  |  |  | 0，9287 | ＜ |
| K | Subject 11 | $>$ | 1，5003 |  |  |  |  |  | 0，1537 |  |  |  |  |  | 0，4829 |  |  |  |  |  | 0，6001 |  | 0，674 |  |  |  | 0，3878 | ＜ |
| L | Subject 12 | $>$ | 1，2579 |  |  |  |  |  | 0，6657 |  |  |  |  |  | 0，3965 |  |  |  |  |  | 0，4483 |  |  |  |  |  | 0，1432 | ＜ |
| M | Subject 13 | $>$ | 0，7716 |  |  |  |  |  | 0，0922 |  |  |  |  |  | 0 |  |  |  |  |  | 0，5309 |  |  |  |  |  | 0，1081 | ＜ |
| N | Subject 14 | $>$ | 1，9229 |  |  |  |  |  | 1，0556 |  |  |  |  |  | 1，3194 |  |  |  |  |  | 1，51 |  | 0，235 |  |  |  | 0，443 | ＜ |
| 0 | Subject 15 | $>$ | 0，8319 |  |  |  |  |  | 0，1805 |  |  |  |  |  | 0，4371 |  |  |  |  |  | 1，1123 |  |  |  |  |  | 0，6969 | ＜ |
| P | Subject 16 | $>$ | 1，0125 |  |  |  |  |  | 0，467 |  |  |  |  |  | 1，2461 |  |  |  |  |  | 1，126 |  |  |  |  |  | 0，0778 | ＜ |
| Q | Subject 17 | $>$ | 0，9151 |  |  |  |  |  | 0，5128 |  |  |  |  |  | 0，7281 |  |  |  |  |  | 1，0294 |  |  |  |  |  | 0，8451 | ＜ |
| R | Subject 18 | $>$ | 1，206 |  |  |  |  |  | 0，9981 |  |  |  |  |  | 0，6976 |  |  |  |  |  | 1，4138 |  |  |  |  |  | 0，1076 | ＜ |



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[^0]:    ${ }^{1}$ Note，however，that many Chinese characters do in fact have phonetic components，or radicals，which help identify the pronunciation of said character（Kess \＆Miyamoto 1999：45；Yeh et al．2017）．Therefore，even Chinese word identification is often subserved by phonological recognition（Kess \＆Miyamoto 1999：8）．

[^1]:    ${ }^{2}$ Coltheart et al. (2001: 236) argue that the DRC model is not quite germane to Japanese, because Kanji characters cannot be used to depict monosyllabic pseudoword. The idea of a non-lexical route subserving the reading process would thereby be defunct. However, the assumption that there are no logographic pseudowords is not true, inasmuch as pseudo-Kanji can be - and for research are - created by combining in-character components, so-called radicals, in non-existent, unique compositions (e.g., Kess \& Miyamoto 1999: 52, 114, 137). Therefore, the DRC model will be treated as being applicable to Japanese.
    ${ }^{3}$ Note, however, that not all dual-route theorists agree with the claim that both routes activate at the same time (Rayner \& Reichle 2010: 789).

[^2]:    ${ }^{4}$ Tergiversate means 'to be avoidant and ambiguous on purpose'.

[^3]:    ${ }^{5}$ In fact，the visual code would be triggered both by the Chinese characters 十二＇ 12 ＇and the Arabic multi－digit number 12 for Chinese and Japanese speakers，considering that both languages also work with Arabic digits （Kess \＆Miyamoto 1999：111，122；Fischer \＆Shaki 2014：1464）．

[^4]:    ${ }^{6}$ This assumes that the L2＋learner of Japanese knows which magnitude corresponds to which Japanese numeral．

[^5]:    ${ }^{7}$ Note, however, that the number 2732 does not need to be restructured into myriads because it is below tenthousand.

[^6]:    ${ }^{8}$ Dotan \& Friedmann (2018: 23) indicate the digit 0 in multi-digit numbers as a defunct node. Therefore, the numbers 302 (with a zero) and 312 (without a zero), for example, would not have the same number tree despite both being three-digit numbers. In the following, the digit 0 will mostly be disregarded.

[^7]:    ${ }^{9}$ Unless the digit 0 is present in a number (Dotan \& Friedmann 2018: 23).
    ${ }^{10}$ Note that Dotan \& Friedmann (2018) call multiplier words decimal words.

[^8]:    ${ }^{11}$ Note that Skagenholt et al. (2018) found that symbolic magnitude (i.e., of numbers) and non-symbolic magnitude (e.g., of differently sized bars) share most but not all brain regions in processing. This chapter focusses on symbolic magnitude for numbers only.

[^9]:    ${ }^{12}$ In this work，Japanese numerals will be represented with Hiragana since it echoes the alphabetic spelling of numerals in the Latin script．The more common use of Kanji characters for numbers is avoided．This is because， for example，the Kanji 九 for the numeral kyuu＇nine＇symbolically portrays the number 9 the same way the Arabic digit 9 does（Kess \＆Miyamoto 1999：122）．Japanese words will also mostly be represented in Hiragana．

[^10]:    ${ }^{13}$ This is a simplified explanation．The exception is the teens：a number like 18 only needs the multiplier word じゅう juи＇ten＇followed by the number word はち hachi ‘eight＇．There is no need for any digit to be enunciated prior to the multiplier word＇ten＇．

