Title: Norms of conceptual familiarity for 3,596 French nouns and its contribution in lexical decision

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Abstract

In the last decade, research has shown that word processing is influenced by lexical and semantic features of words. However, norms for a crucial semantic variable, i.e. conceptual familiarity, were not available for a sizeable French database. We thus developed French Canadian conceptual familiarity norms for 3,596 nouns. This enriches Desrochers and Thompson's (2009) database in which subjective frequency and imageability values are already available for the same words. We collected online data from 313 French Canadian speakers. The full database of conceptual familiarity ratings is freely available on http://lingualab.ca/fr/projets/normes-de-familiarite-conceptuelle. We then demonstrated the utility of these new conceptual familiarity norms by assessing its contribution to lexical decision. We conducted a stepwise regression model with conceptual familiarity in the last step. This allowed us to assess the independent contribution of conceptual familiarity beyond the contribution of other well-known psycholinguistic variables, such as frequency, imageability and age of acquisition. Results showed that conceptual familiarity facilitated lexical decision latencies. In sum, these ratings will help researchers select French stimuli for experiments in which conceptual familiarity must be taken into account.

Introduction

A great deal of research in psycholinguistics has focused on the impact of stimulus characteristics on language performance. These studies have made it possible to critically advance our knowledge of the cognitive mechanisms involved in different language functions (Huth, de Heer, Griffiths, Theunissen, & Gallant, 2016). To be conducted successfully, these studies require comprehensive culture- and language-specific psycholinguistic databases, including norms of the characteristics of the stimuli commonly employed in language tasks, such as words or pictures. These databases are of great value for conducting a wide variety of cognitive experiments. The current study provides French Canadian norms of conceptual familiarity for 3,600 nouns. This will enrich Desrochers and Thompson's (2009) database, in which subjective frequency and imageability are already available for the same words.

It is widely accepted that word-form (e.g., word length), lexical (e.g., objective word frequency) and semantic variables (e.g., imageability, age of acquisition or AoA) influence language processing of written stimuli, as observed using both lexical decision and word naming tasks (Alario & Ferrand, 1999; Baluch & Besner, 2001; Cortese & Schock, 2013; Evans, Lambon Ralph, & Woollams, 2017; Ferrand et al., 2008; Strain & Herdman, 1999; Strain, Patterson, & Seidenberg, 1995; Zevin & Balota, 2000). Some of these variables are mostly based on objective measures (i.e., the number of letters or syllables, the first letter or phoneme of a stimulus, objective word frequencies based on film subtitles or written corpora), and they are already available in French (see, for example, the database Lexique, http://www.lexique.org/ (New, Pallier, Brysbaert, & Ferrand, 2004).

Recently, French Canadian norms for two variables, imageability and subjective frequency, have become available for a large dataset of French words through a subjective rating study (Desrochers

& Thompson, 2009). Word imageability refers to how easily a word can elicit a mental representation of the word's referent (Toglia & Battig, 1978). Subjective frequency refers to the subjective assessment of how often a word is encountered in everyday life (Desrochers, Liceras, Fernandez-Fuertes, & Thompson, 2010; Ferrand et al., 2008; Soares, Costa, Machado, Comesana, & Oliveira, 2017). French Canadian norms for these two variables have been assessed by means of a 7-point Likert scale in which the closer the values are to 7 means higher imageability or subjective frequency and vice versa (Desrochers & Thompson, 2009). Various studies have reported that both variables modulate reaction times in different tasks employing word stimuli, such as lexical decision, word naming, and semantic categorization (Garber & Pisoni, 1991; Pisoni & E. Garber, 1990). More specifically, high levels of imageability and of subjective frequency facilitate word processing (Gaygen & Luce, 1998; Strain & Herdman, 1999; Strain et al., 1995; Wilson, Cuetos, Davies, & Burani, 2013).

Other than imageability, more recent evidence has pointed towards the role of another semantic variable, i.e. conceptual familiarity, in word processing. Conceptual familiarity refers to the degree to which participants feel they are familiar with the concept expressed by a word or a picture (Moreno-Martinez, Montoro, & Rodriguez-Rojo, 2014; Schroder, Gemballa, Ruppin, & Wartenburger, 2012). It has been reported that conceptual familiarity has a facilitatory effect on word reading (Yamazaki, Ellis, Morrison, & Ralph, 1997), word comprehension and word memorization tasks (Funnell & Davies, 1996; Lambon Ralph, Graham, Ellis, & Hodges, 1998; Woollams, Taylor, Karayanidis, & Henson, 2008), picture naming latencies (Ellis & Morrison, 1998; Feyereisen, Van der Borght, & Seron, 1988; Snodgrass & Vanderwart, 1980). In addition, a previous study has revealed the independent contribution of conceptual familiarity to naming speed, beyond the contribution of other critical psycholinguistic variables, such as age of acquisition, name agreement, word frequency and imageability (Ellis & Morrison, 1998). Conceptual familiarity is highly correlated with, AoA (e.g. Juhasz, 2005), another semantic variable referring to the age at which a word was learned (e.g. Gilhooly & Logie, 1980; Kuperman, Stadthagen-Gonzalez, & Brysbaert, 2012). AoA has a facilitatory effect on word processing, with words learned early in life being processed faster and with fewer errors than words learned later in life (Ellis & Morrison, 1998; Juhasz, 2005; Wilson et al., 2013; Wilson, Ellis, & Burani, 2012). However, the specific contribution of conceptual familiarity on word processing beyond that of AoA has yet to be reported.

Several databases exist with norms for conceptual familiarity based on pictures in different languages such as German (Schroder et al., 2012), Spanish (Moreno-Martinez et al., 2014), Italian (Della Rosa, Catricala, Vigliocco, & Cappa, 2010), Portuguese (Soares, Pureza, & Comesana, 2018), Russian (Tsaparina, Bonin, & Meot, 2011), Turkish (Raman, Raman, & Mertan, 2014), Tunisian Arabic (Boukadi, Zouaidi, & Wilson, 2016), Icelandic (Pind, Jonsdottir, Tryggvadottir, & Jonsson, 2000), and French (Alario & Ferrand, 1999; Bonin, Peereman, Malardier, Meot, & Chalard, 2003). In French, the language of the present study, conceptual familiarity norms are available for a set of 299 black-and-white pictures (Bonin et al., 2003). The procedure used to collect data for conceptual familiarity followed closely the study of Alario and Ferrand (1999) who provided normative data for 400 pictures. To rate conceptual familiarity, participants were asked to evaluate the familiarity of the concept depicted by each picture according to how usual or unusual the object was in their realm of experience, and not to the way it was represented. Participants were carefully informed on the exact meaning of familiarity measured by defining it by “the degree to which they come in contact with or think about the concept”. These instructions are consistent with those employed in previous studies of conceptual familiarity, such as Ellis and

Morrison (1998) and Pind, Jonsdottir, Tryggvadottir, and Jonsson (2000). The databases available in French for conceptual familiarity include a limited number of concepts, partly because they are exclusively based on picture stimuli. Here, we developed a sizeable database based on more than 3,000 words (Desrochers & Thompson, 2009), which allowed us to evaluate a greater number of concepts.

Language-specific normative studies are important because, as noted by Sanfeliu and Fernandez (1996), responses to the same stimuli can vary significantly with respect to certain standards, not only in different languages (Sanfeliu & Fernandez, 1996) but also in different cultures (e.g., French in Canada and in France) (Sirois, Kremin, & Cohen, 2006). For this reason, it has been suggested that normative data should be collected for each culture separately (Bonin et al, 2003).

Therefore, the present study has two main objectives. The first objective (Study 1) is to provide French Canadian norms for conceptual familiarity for a sizeable database of 3,600 words taken from Desrochers and Thompson (2009). The second objective (Study 2) is to demonstrate the contribution of conceptual familiarity to word processing, and more specifically to lexical decision reaction times, above and beyond that of other known psycholinguistic variables.

STUDY 1

The aim of this study was to establish French Canadian norms for conceptual familiarity for 3,600 nouns from various semantic categories taken from Desrochers and Thompson's (2009) database.

Method

Participants

Three hundred and thirteen participants were involved in the rating task (234 females and 79 males, mean age: 24.2 years, SD: 4.6 years; age range: 18-35 years; mean education in years: 15.9, SD:

2.7). Participants were recruited from the École des hautes études commerciales de Montréal (HEC) panel, a bank of participants (mainly students from the University of Montreal) who have previously agreed to be contacted to participate in research studies. The inclusion criteria were as follows: 1) being aged between 18 and 35 years, 2) being native speakers of French Canadian and having French as their mother tongue, 3) having normal or corrected-to-normal vision, and 4) having no previous history of reading and/or mental problems. Participants received a 10 CAD$ gift card as compensation after completing each session.

The study was reviewed and approved by the local ethics committee (Comité d'éthique de la recherche vieillissement-neuroimagerie CER IUGM 15-16-33). This committee follows the guidelines of the Tri-Council Policy Statement of Canada, the civil code of Quebec, the Declaration of Helsinki, and the Nuremberg Code.

Stimuli

We selected the 3,600 French nouns from Desrochers and Thompson's (2009) database. Following similar procedures used with sizeable databases (Balota et al., 2007; Ferrand et al., 2010), we randomly divided the stimuli into 24 sessions of 150 items each. In each session, five randomly selected words appeared twice in a semi-random order to calculate test-retest reliability of each participant's ratings. Thus, a total of 155 words (including the five repeated words) were presented in each session.

Procedure

The timing, sequencing, presentation of stimuli, response recording, and response latencies were controlled by a web application created by Beau and Rey (2015) and previously used in Rey, Riou, Vallet, and Versace (2017). Participants completed the rating study by means of an online platform. The web method for collecting normative data has been proved to be as valid that a paper/pencil method (Soares, Comesana, Pinheiro, Simoes, & Frade, 2012) and it was used in several studies (Lahl, Goritz, Pietrowsky, & Rosenberg, 2009; Rey et al., 2017). Once participants reached the online webpage of the study, they were required to fill out an identification page with personal information (age, gender, highest educational level, years of education, and other spoken languages), as well as a screening questionnaire in order to ensure that all the inclusion criteria were met. Then, participants read and approved the consent form to participate in the study. Personal and screening data were saved into a file that was accessible only to the principal investigators (S.M.B. and G.C.). Eligible participants received, via e-mail, a link that allowed them to access the session in which they had to rate the familiarity of 155 words. Each participant could complete a single session or continue with more sessions by obtaining different codes. Fifty-nine participants completed more than a single rating session (maximum rating sessions per participant = 24). Participants were not allowed to complete the same session more than once. The ratings were automatically saved by the server in a secure database (PostgreSQL). The principal investigators could query the database and extract data in an Excel file for further analysis. No personal data were saved in the anonymized ratings file.

The rating session began with an instructions page. It contained a definition of the variable to be rated, instructions for the rating procedure and examples. The instructions were the same used in a previous article rating conceptual familiarity for pictures in a group of French participants (Bonin et al., 2003). The words to be rated appeared on the screen one at a time, centered in the upper part of the screen. The words were presented in lowercase, 16-point Times New Roman font. For each word, participants had to rate its conceptual familiarity. An explanation was given on how to evaluate the familiarity of the concept according to how usual or unusual the object was in their realm of experience (Bonin et al., 2003). For instance, the word 'DOG' was presented in the upper part of the screen, together with the following sentence that appeared below the word to be rated: "To what extent do you feel familiar with the concept of DOG?". Underneath this sentence, a continuous horizontal line appeared for the ratings. As in other studies, we used an uncalibrated bar and participants were asked to move the cursor on this uncalibrated line to optimize the variability in ratings as answers are not restricted to a certain number of response options but very fine gradations can be measured (Gerich, 2007; Reips & Funke, 2008). The left side of the line corresponded to "very low familiarity", and the right side to "very high familiarity". The cursor always appeared in the center of the line, and the participant had to move it to the position that represented his/her rating on the continuum from left to right. If the participant felt familiar with the concept "DOG", he/she would move the cursor towards the right side of the line, while if it was unfamiliar, he/she would move the cursor towards the left side of the line. After rating the conceptual familiarity of the word, participants clicked on the "Next" button to rate a new word. Word order presentation was randomized within each session.

The position on the bar selected by the participants was automatically coded as a number on a scale from 0 (extreme left) to 100 (extreme right) for the conceptual familiarity. In addition, the rating latencies were recorded to control for the quality of the ratings (e.g. that a participant did not rate some words too quickly or too slowly).

Completing a session meant giving estimations for a list of 155 words. Participants were instructed to complete the session in a calm place without any interruption for the total duration of the session, which did not exceed 90 minutes. If a participant did not finish his/her ratings within this time limit, the session closed automatically and his/her ratings were not included in further analysis.

Data Screening

After an initial inspection of the collected data, the data of six participants were excluded because the same answer was given to all items (for example, 100). Accordingly, their response time to all concepts was less than 0.3 seconds, which is congruent with lack of commitment to the task.

We further inspected the data for outliers in each session. Scores falling outside ±3.5 standard deviations from the mean were classified as outliers. The data of five participants were then eliminated according to this criterion. Regarding rating latencies, visual inspection of the reaction time distribution suggested that responses with latencies less than 300 ms were derived from a distinct distribution (Desrochers & Thompson, 2009). As a result, such responses were excluded and not analyzed. A total of 313 participants remained. Each session was evaluated by a mean of 23 participants (minimum raters per session = 16; maximum raters per session= 30).

Results

Desrochers and Thomson's (2009) original database comprises 3,600 nouns. We noticed that the word "vague" (in English, the noun "wave" or the adjective "vague") was repeated. According to the information available in the French online database Lexique.org, "vague", as a noun, has only one entry. We thus eliminated the second entry. Due to technical difficulties with the online presentation mechanism, 3 additional words were omitted from rating sessions ("avant", "chose", and "lit", corresponding to the English words "before", "thing" and "bed", respectively). We therefore provide norms for a database of 3,596 French nouns. The database is freely available for download at the following website: http://lingualab.ca/fr/projets/normes-de-familiarite-conceptuelle.

Reliability of conceptual familiarity

Intrastudy reliability

To assess the reliability of the ratings in the study, we performed two main analyses consistent with the previous published norm studies by Bonin et al. and by Desrochers & Bergeron (Bonin et al., 2003; Desrochers et al., 2010). First, for within-words stimulus reliability, we computed split-half correlations of the mean rating values for all the words across the 24 sessions. Word ratings for individual raters were divided into two groups –even and odd– according to the order in which they were provided. We calculated the mean rating for each word in each group (even and odd). Then, we correlated the means of the two groups. The corrected Pearson correlations were $r(502) = .848$, $p < .01$. We also confirmed the high degree of internal consistency between raters by examining Cronbach's alpha that reached 0.913.

Second, we measured the consistency of the responses between participants. To that end, we compared the 120 words (the 5 words repeated within each of the 24 sessions for a total of 120 words) that received double estimations. We computed Pearson's correlation between the two responses given for the 120 repeated words across all sessions to make sure that participants were reliably giving approximately the same estimation for the same word when it appeared randomly twice in a session. The results showed a high correlation between the first and second ratings of the same words, $r(240) = .769$, $p < .01$. The repeated answers had a high level of internal consistency, as determined also by a Cronbach's alpha of 0.870.

Interstudy reliability

We examined interstudy reliability by testing the association between the ratings of conceptual familiarity based on word stimuli obtained in our study and those previously obtained in French

(Alario & Ferrand, 1999; Bonin et al., 2003). To this aim, we run cross-study correlations on stimuli common to our database and the databases used in the studies by Alario & Ferrand (1999) and by Bonin et al. (2003). The analysis showed a significant and positive correlation for the 266 stimuli common to our database and that of Alario and Ferrand (1999), r (266) = 0.402, p <.01, and for the 166 stimuli common to our database and that of Bonin and colleagues (2003), r (166) = 0.262, p <.01.

Summary of the results

We collected norms for conceptual familiarity for 3,596 nouns from various semantic categories taken from Desrochers and Thompson's (2009) database. We obtained information on the intrastudy and interstudy reliability of our new ratings. For the intrastudy reliability, we used two indicators: the correlation between the average ratings from two halves of the data (even vs odd items) and the correlation between the mean first and second ratings of the 120 words repeated across the 24 sessions. Both indicators good revealed intra-study reliability. We also studied the interstudy reliability between our conceptual familiarity ratings based on words and the rating based on pictures obtained in previous studies in French. The positive and significant correlation with other French normative databases confirmed the interstudy reliability of our ratings.

STUDY 2

The aim of this study was to assess the independent contribution of our newly developed conceptual familiarity ratings to lexical decision reaction times (RTs) beyond that of other well-known psycholinguistic variables that have been previously shown to have a significant impact on lexical decision RTs. To that end, we conducted a stepwise regression model in which we entered lexical decision RTs as dependent variable. In Step 1 we introduced imageability, subjective and objective frequencies, word length, orthographic similarity and AoA in the model (Andrews, 1989; Balota & Chumbley, 1984; Barton, Hanif, Eklinder Bjornstrom, & Hills, 2014; Cortese & Schock, 2013; Forster & Chambers, 1973). We entered conceptual familiarity in Step 2 as our variable of interest.

Methods

Materials

Based on previous studies (Andrews, 1989; Balota & Chumbley, 1984; Barton et al., 2014; Forster & Chambers, 1973), we extracted the values of the following psycholinguistic variables for the 3,596 nouns of Study 1 from the French online database Lexique (New et al., 2004) (www.lexique.org): word length in number of letters (N-letters; e.g., concept = 7); word length in number of syllables (N-syllables; e.g., concept = 2); objective lexical frequency calculated from books (FreqBooks) (e.g., concept = 7.63 occurrences per million); two measures of orthographic similarity: (1) orthographic neighborhood size or N-size (i.e. number of words that can be generated by switching one letter, laughter → daughter) and (2) orthographic Levenshtein distance 20 (OLD20) (i.e. the minimum number of insertions, deletions, and substitution required to turn one word into the 20 nearest neighbors) (Yarkoni, Balota, & Yap, 2008).

We also obtained the values for subjective frequency, taken from Desrochers and Thompson (2009), and two semantic variables: (1) imageability (Desrochers & Thompson, 2009) and (2) AoA (Ferrand et al., 2008).

We subsequently extracted the mean lexical decision reaction times (RTs) for each word from the French Lexicon Project (Ferrand et al., 2010) (http://brm.psychonomic-journals.org/content/supplemental). AoA was available only for small subset of words in our database (420 nouns), while the other variables were available for 3,124 words. To study the contribution of conceptual familiarity with a sizeable set of stimuli and even in the presence of other semantic variable, such as AoA, we conducted two separate stepwise regression models. The first model was run on 3,124 words and did not include AoA in Step 1 (Study 2.a.). The second model was run on 420 words and included AoA in Step 1 (Study 2.b.).

Study 2.a.

Data analysis

We inspected the data for multicollinearity. To this aim, we ran a regression model entering lexical decision RTs as the dependent variable and N-letters, N-syllables, N-size, OLD20, FreqBooks, subjective frequency, imageability and conceptual familiarity as independent variables. Based on this analysis, we calculated the tolerance and variance inflation factor (VIF). The results showed VIF < 4 and tolerance > 0.2, indicating absence of multicollinearity among our variables (Menard, 1995). To further investigate collinearity, we explored the correlation matrix to detect pairs of variables showing coefficients greater than .75 (Cohen, Cohen, West, & Aiken, 2003). Analysis showed correlation coefficient greater than .75 between OLD20 and N-letters, $r\ (3124) = .785$, $p<.01$, and between N-letters and N-syllables, $r\ (3124) = .796$, $p<.01$. Based on the results of the correlation matrix and the fact that a measure of word length was already included in the model (i.e., N-syllables), we decided to exclude N-letters from the stepwise regression analysis model. We then retested multicollinearity without N-letters, obtaining VIF < 3 and tolerance > 0.2. Table 1 shows descriptive statistics and tolerance/VIF values for all variables included in the stepwise regression model. Table 2 shows the correlations between all the variables used as predictors (and the dependent variable RTs) in the lexical decision task.

Following similar previous studies (Della Rosa et al., 2010; Lynott & Connell, 2013), we grouped the predictors and entered them in a regression model with two steps. Step 1 included N-syllables, FreqBooks, N-size, OLD20, subjective frequency and imageability. Step 2 included the newly calculated variable, i.e. conceptual familiarity. Lexical decision RTs were the dependent variable.

Results

Table 3 shows the results of the regression model with conceptual familiarity in the final step. After controlling for the effect of the other psycholinguistic variables (Step 1), we observed a significant facilitatory effect of conceptual familiarity on lexical decision reaction times (β = -.285, $p < .001$).

Study 2.b.

Data Analysis

This analysis included only the 420 words for which AoA ratings were available (Ferrand et al., 2008). Variable N-syllables was not entered in Step 1 because all 420 words were monosyllabic. To test data for multicollinearity, we ran a regression model entering lexical decision RTs as dependent variable and N-letters, N-size, OLD20, FreqBooks, subjective frequency, imageability, AoA and conceptual familiarity as independent variables. The results showed a VIF > 5 (VIF=5.4) and tolerance < 0.2 (tolerance = 0.18) for N-size (Menard, S., 1995). This variable showed a correlation of> 0.75 with OLD20 values. Based on these results and the fact that another variable assessing neighborhood (OLD20) was included in Step 1, N-size was excluded from the regression model. The test of collinearity after the exclusion of N-size yielded VIF < 3 and tolerance > 0.3. The correlation coefficients between all variables were < 0.75 (Cohen, Cohen, West, & Aiken, 2003).

Table 4 shows correlations between all the variables included as predictors and the dependent variable RTs in the lexical decision task.

A stepwise regression analysis was conducted with lexical decision RTs as the dependent variable. Step 1 included N-letters, OLD20, FreqBooks, subjective frequency, imageability and AoA. Step 2 included conceptual familiarity as independent variables.

Results

Table 5 shows the results of the stepwise regression analysis. We observed a significant facilitatory effect of conceptual familiarity on lexical decision RTs ($\beta = -.187$, $p < .005$).

GENERAL DISCUSSION

The present study had two aims: a) to provide French Canadian norms for conceptual familiarity for a large database of 3,596 French nouns, and b) to determine the contribution of this newly developed variable to lexical decision latencies. To achieve the first goal, we used the same 3,600 nouns for which Thompson and Desrochers (2009) had previously provided French Canadian norms of subjective frequency and imageability. Each noun was assessed online by a mean of 23 native Canadian French speakers. We subsequently studied the reliability of the new ratings, both intrastudy (between the participants of the study) and interstudy (between our norms and other French published conceptual familiarity ratings based on pictorial stimuli of Alario & Ferrand, (1999) and Bonin et al., (2003)). Both interstudy and intrastudy analyses showed a high reliability and confirmed the validity of our new database. To the best of our knowledge, this is the first study that provides conceptual familiarity norms for a large database of French Canadian words. In fact, only two previous studies have provided ratings for conceptual familiarity in French (Alario & Ferrand, 1999; Bonin et al., 2003). However, those previous studies were based on smaller databases of pictorial stimuli. Although our interstudy reliability analysis revealed that our norms significantly correlated with the norms of these previous studies, the strength of the relationship was moderate. This result can be partly attributed to the different nature of the stimuli employed in these studies (pictorial stimuli in Alario & Ferrand, 1999 and Bonin et al., 2003 and written words in the present study). Further studies comparing conceptual familiarity ratings based on pictorial and word stimuli would be useful to confirm this hypothesis.

To illustrate the crucial role of our ratings on word processing and the potential of this database in language research, we studied the contribution of conceptual familiarity to lexical decision latencies. Lexical decision is the most frequently used task in the visual word recognition literature to examine semantic effects (Balota & Chumbley, 1984; Cortese & Schock, 2013; G. A. Evans, Lambon Ralph, & Woollams, 2012). The results of our regression model showed that conceptual familiarity significantly contributed to lexical decision latencies, over and beyond the contribution of other psycholinguistic and semantic variables that have previously shown a facilitatory effect on lexical decision latencies. These variables included measures of word length, objective frequency, lexical neighborhood, and ratings of imageability, subjective frequency and age of acquisition (Andrews, 1989; Balota & Chumbley, 1984; Barton et al., 2014; Desrochers & Thompson, 2009; Forster & Chambers, 1973). More specifically, our analyses revealed that conceptual familiarity had a facilitatory effect on latencies since it was associated with reduced RTs during lexical decision.

Our results are in agreement with previous studies showing that conceptual familiarity is known to have a facilitatory effect on the speed and accuracy of word processing in both healthy (Izura, Hernandez-Munoz, & Ellis, 2005; Schroder et al., 2012) and brain-damaged participants (Bowles, Duke, Rosenbaum, McRae, & Kohler, 2016). Higher conceptual familiarity facilitates the speed with which a stimulus is responded to and facilitates correct judgements (Connine, Mullennix, Shernoff, & Yelen, 1990). Connine and colleagues (1990) found that, when participants performed a lexical decision task, accuracy increased with familiarity. Moreover, lexical decision reaction times for highly familiar concepts were faster than those for low familiar ones. Another piece of evidence on the influence of conceptual familiarity comes from a Japanese study that showed that it had a facilitatory effect, increasing the speed at which single kanji characters can be read (Yamazaki et al., 1997). In a study of category fluency for 500 Spanish words, Izura et al. (2005) found that lexical availability, or the ease with which a word can be accessed and produced as a member of a given category in Spanish, is well predicted by conceptual familiarity and other variables such as typicality, age of acquisition and word frequency. Moreover, a facilitatory effect of conceptual familiarity on lexical decision in French-speaking subjects has also been reported when norms of conceptual familiarity were based on picture stimuli and not on word stimuli as in our study (Alario & Ferrand, 1999; Bonin et al., 2003). Accordingly, conceptual familiarity had a facilitatory effect not only on the processing of words but also pictures. For example, an early research of Ellis and Morrison (1998) on conceptual familiarity found an independent contribution of conceptual familiarity to picture naming speed, beyond the contribution of age of acquisition, name agreement, word frequency and other variables (Ellis & Morrison, 1998). The impact of conceptual familiarity on picture naming finds further confirmation in studies on clinical patients. It has been shown that performance on picture naming tasks in patients with semantic deficits is strongly affected by conceptual familiarity (Funnell & Davies, 1996). More specifically, these patients produced a higher number of correct responses in the naming of pictures representing highly-familiar compared to low-familiar concepts. The fact that conceptual familiarity affects the processing of both words and pictures further highlights the semantic nature of this variable.

In sum, our results are consistent with the established notion of conceptual familiarity as a facilitator which might influence performance in word processing. Additionally, our study provides researchers with the largest database of French Canadian ratings of conceptual familiarity. Our ratings complement the French Canadian ratings of subjective frequency and imageability previously obtained with the same word database. We hope that this sizeable database proves to be a useful tool for researchers working in the areas related to psycholinguistics, education and language acquisition or language disorders in French Canadian speaking populations.

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REFERENCES

Alario, F. X., & Ferrand, L. (1999). A set of 400 pictures standardized for French: norms for name agreement, image agreement, familiarity, visual complexity, image variability, and age of acquisition. *Behav Res Methods Instrum Comput, 31*(3), 531-552.

Andrews, S. (1989). *Frequency and Neighborhood Effects on Lexical Access: Activation or Search?* (Vol. 15).

Balota, & Chumbley, J. I. (1984). Are lexical decisions a good measure of lexical access? The role of word frequency in the neglected decision stage. *J Exp Psychol Hum Percept Perform, 10*(3), 340-357.

Balota, Yap, M. J., Cortese, M. J., Hutchison, K. A., Kessler, B., Loftis, B., . . . Treiman, R. (2007). The English Lexicon Project. *Behav Res Methods, 39*(3), 445-459.

Baluch, B., & Besner, D. (2001). Basic processes in reading: semantics affects speeded naming of high-frequency words in an alphabetic script. *Can J Exp Psychol, 55*(1), 63-69.

Barton, J. J., Hanif, H. M., Eklinder Bjornstrom, L., & Hills, C. (2014). The word-length effect in reading: a review. *Cogn Neuropsychol, 31*(5-6), 378-412. doi:10.1080/02643294.2014.895314

Beau, S., & Rey, A. (2015). Github repository, https://github.com/sebastienbeau/aphrodite-survey.

Bonin, P., Peereman, R., Malardier, N., Meot, A., & Chalard, M. (2003). A new set of 299 pictures for psycholinguistic studies: French norms for name agreement, image agreement, conceptual familiarity, visual complexity, image variability, age of acquisition, and naming latencies. *Behav Res Methods Instrum Comput, 35*(1), 158-167.

Boukadi, M., Zouaidi, C., & Wilson, M. A. (2016). Norms for name agreement, familiarity, subjective frequency, and imageability for 348 object names in Tunisian Arabic. *Behav Res Methods, 48*(2), 585-599. doi:10.3758/s13428-015-0602-3

Bowles, B., Duke, D., Rosenbaum, R. S., McRae, K., & Kohler, S. (2016). Impaired assessment of cumulative lifetime familiarity for object concepts after left anterior temporal-lobe resection that includes perirhinal cortex but spares the hippocampus. *Neuropsychologia, 90*, 170-179. doi:10.1016/j.neuropsychologia.2016.06.035

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences, 3rd ed*. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers.

Connine, C. M., Mullennix, J., Shernoff, E., & Yelen, J. (1990). Word familiarity and frequency in visual and auditory word recognition. *J Exp Psychol Learn Mem Cogn, 16*(6), 1084-1096.

Cortese, M. J., & Schock, J. (2013). Imageability and age of acquisition effects in disyllabic word recognition. *Q J Exp Psychol (Hove), 66*(5), 946-972. doi:10.1080/17470218.2012.722660

Della Rosa, P. A., Catricala, E., Vigliocco, G., & Cappa, S. F. (2010). Beyond the abstract-concrete dichotomy: mode of acquisition, concreteness, imageability, familiarity, age of acquisition, context availability, and abstractness norms for a set of 417 Italian words. *Behav Res Methods, 42*(4), 1042-1048. doi:10.3758/BRM.42.4.1042

Desrochers, A., Liceras, J. M., Fernandez-Fuertes, R., & Thompson, G. L. (2010). Subjective frequency norms for 330 Spanish simple and compound words. *Behav Res Methods, 42*(1), 109-117. doi:10.3758/BRM.42.1.109

Desrochers, A., & Thompson, G. L. (2009). Subjective frequency and imageability ratings for 3,600 French nouns. *Behav Res Methods, 41*(2), 546-557. doi:10.3758/BRM.41.2.546

Ellis, A. W., & Morrison, C. M. (1998). Real age-of-acquisition effects in lexical retrieval. *J Exp Psychol Learn Mem Cogn, 24*(2), 515-523.

Evans, G., Lambon Ralph, M. A., & Woollams, A. M. (2017). Seeing the Meaning: Top-Down Effects on Letter Identification. *Front Psychol, 8*, 322. doi:10.3389/fpsyg.2017.00322

Ferrand, L., Bonin, P., Meot, A., Augustinova, M., New, B., Pallier, C., & Brysbaert, M. (2008). Age-of-acquisition and subjective frequency estimates for all generally known monosyllabic French words and their relation with other psycholinguistic variables. *Behav Res Methods, 40*(4), 1049-1054. doi:10.3758/BRM.40.4.1049

Ferrand, L., New, B., Brysbaert, M., Keuleers, E., Bonin, P., Meot, A., . . . Pallier, C. (2010). The French Lexicon Project: lexical decision data for 38,840 French words and 38,840 pseudowords. *Behav Res Methods, 42*(2), 488-496. doi:10.3758/BRM.42.2.488

Feyereisen, P., Van der Borght, F., & Seron, X. (1988). The operativity effect in naming: a re-analysis. *Neuropsychologia, 26*(3), 401-415.

Forster, K. I., & Chambers, S. M. (1973). Lexical access and naming time. *Journal of Verbal Learning and Verbal Behavior, 12*(6), 627-635. doi:https://doi.org/10.1016/S0022-5371(73)80042-8

Funnell, E., & Davies, P. D. M. (1996). JBR: A reassessment of concept familiarity and a category-specific disorder for living things. *Neurocase, 2*(6), 461-474. doi:10.1080/13554799608402422

Garber, E. E., & Pisoni, D. B. (1991). Lexical memory in visual and auditory modalities: A second report.Research on speech perception *Prog. Rep., No. 17*, 213–227.

Gaygen, D. E., & Luce, P. A. (1998). Effects of modality on subjective frequency estimates and processing of spoken and printed words. *Percept Psychophys, 60*(3), 465-483.

Gerich, J. (2007). Visual analogue scales for mode-independent measurement in self-administered questionnaires. *Behav Res Methods, 39*(4), 985-992.

Gilhooly, K. J., & Logie, R. H. (1980). Age-of-acquisition, imagery, concreteness, familiarity, and ambiguity measures for 1,944 words. *Behavior Research Methods & Instrumentation, 12*(4), 395-427. doi:10.3758/bf03201693

Huth, A. G., de Heer, W. A., Griffiths, T. L., Theunissen, F. E., & Gallant, J. L. (2016). Natural speech reveals the semantic maps that tile human cerebral cortex. *Nature, 532*(7600), 453-458. doi:10.1038/nature17637

Izura, C., Hernandez-Munoz, N., & Ellis, A. W. (2005). Category norms for 500 Spanish words in five semantic categories. *Behav Res Methods, 37*(3), 385-397.

Juhasz, B. J. (2005). Age-of-acquisition effects in word and picture identification. *Psychol Bull, 131*(5), 684-712. doi:10.1037/0033-2909.131.5.684

Kuperman, V., Stadthagen-Gonzalez, H., & Brysbaert, M. (2012). Age-of-acquisition ratings for 30,000 English words. *Behav Res Methods, 44*(4), 978-990. doi:10.3758/s13428-012-0210-4

Lahl, O., Goritz, A. S., Pietrowsky, R., & Rosenberg, J. (2009). Using the World-Wide Web to obtain large-scale word norms: 190,212 ratings on a set of 2,654 German nouns. *Behav Res Methods, 41*(1), 13-19. doi:10.3758/BRM.41.1.13

Lambon Ralph, M. A., Graham, K. S., Ellis, A. W., & Hodges, J. R. (1998). Naming in semantic dementia--what matters? *Neuropsychologia, 36*(8), 775-784.

Lynott, D., & Connell, L. (2013). Modality exclusivity norms for 400 nouns: the relationship between perceptual experience and surface word form. *Behav Res Methods, 45*(2), 516-526. doi:10.3758/s13428-012-0267-0

Menard, S. (1995). *Applied Logistic Regression Analysis: Sage University Series on Quantitative Applications in the Social Sciences*: Thousand Oaks, CA: Sage.

Moreno-Martinez, F. J., Montoro, P. R., & Rodriguez-Rojo, I. C. (2014). Spanish norms for age of acquisition, concept familiarity, lexical frequency, manipulability, typicality, and other variables for 820 words from 14 living/nonliving concepts. *Behav Res Methods, 46*(4), 1088-1097. doi:10.3758/s13428-013-0435-x

New, B., Pallier, C., Brysbaert, M., & Ferrand, L. (2004). Lexique 2: a new French lexical database. *Behav Res Methods Instrum Comput, 36*(3), 516-524.

Pind, J., Jonsdottir, H., Tryggvadottir, H. B., & Jonsson, F. (2000). Icelandic norms for the Snodgrass and Vanderwart (1980) pictures: name and image agreement, familiarity, and age of acquisition. *Scand J Psychol, 41*(1), 41-48.

Pisoni, D., & E. Garber, E. (1990). Lexical memory in visual and auditory modalities: the case for a common mental lexicon.

Raman, I., Raman, E., & Mertan, B. (2014). A standardized set of 260 pictures for Turkish: norms of name and image agreement, age of acquisition, visual complexity, and conceptual familiarity. *Behav Res Methods, 46*(2), 588-595. doi:10.3758/s13428-013-0376-4

Reips, U. D., & Funke, F. (2008). Interval-level measurement with visual analogue scales in Internet-based research: VAS Generator. *Behav Res Methods, 40*(3), 699-704.

Rey, A. E., Riou, B., Vallet, G. T., & Versace, R. (2017). The automatic visual simulation of words: A memory reactivated mask slows down conceptual access. *Can J Exp Psychol, 71*(1), 14-22. doi:10.1037/cep0000100

Sanfeliu, M. C., & Fernandez, A. (1996). A set of 254 Snodgrass-Vanderwart pictures standardized for Spanish: Norms for name agreement, image agreement, familiarity, and visual complexity. *Behavior Research Methods, Instruments, & Computers, 28*(4), 537-555. doi:10.3758/bf03200541

Schroder, A., Gemballa, T., Ruppin, S., & Wartenburger, I. (2012). German norms for semantic typicality, age of acquisition, and concept familiarity. *Behav Res Methods, 44*(2), 380-394. doi:10.3758/s13428-011-0164-y

Sirois, M., Kremin, H., & Cohen, H. (2006). Picture-naming norms for Canadian French: name agreement, familiarity, visual complexity, and age of acquisition. *Behav Res Methods, 38*(2), 300-306.

Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: norms for name agreement, image agreement, familiarity, and visual complexity. *J Exp Psychol Hum Learn, 6*(2), 174-215.

Soares, A. P., Comesana, M., Pinheiro, A. P., Simoes, A., & Frade, C. S. (2012). The adaptation of the Affective Norms for English Words (ANEW) for European Portuguese. *Behav Res Methods, 44*(1), 256-269. doi:10.3758/s13428-011-0131-7

Soares, A. P., Costa, A. S., Machado, J., Comesana, M., & Oliveira, H. M. (2017). The Minho Word Pool: Norms for imageability, concreteness, and subjective frequency for 3,800 Portuguese words. *Behav Res Methods, 49*(3), 1065-1081. doi:10.3758/s13428-016-0767-4

Soares, A. P., Pureza, R., & Comesana, M. (2018). Portuguese Norms of Name Agreement, Concept Familiarity, Subjective Frequency and Visual Complexity for 150 Colored and Tridimensional Pictures. *Span J Psychol, 21*, E8. doi:10.1017/sjp.2018.10

Strain, E., & Herdman, C. M. (1999). Imageability effects in word naming: an individual differences analysis. *Can J Exp Psychol, 53*(4), 347-359.

Strain, E., Patterson, K., & Seidenberg, M. S. (1995). Semantic effects in single-word naming. *J Exp Psychol Learn Mem Cogn, 21*(5), 1140-1154.

Toglia, M. P., & Battig, W. F. (1978). *Handbook of semantic word norms*: Halsted Press Division of John Wiley, Hillsdale, N.J.

Tsaparina, D., Bonin, P., & Meot, A. (2011). Russian norms for name agreement, image agreement for the colorized version of the Snodgrass and Vanderwart pictures and age of acquisition, conceptual familiarity, and imageability scores for modal object names. *Behav Res Methods, 43*(4), 1085-1099. doi:10.3758/s13428-011-0121-9

Wilson, M. A., Cuetos, F., Davies, R., & Burani, C. (2013). Revisiting age-of-acquisition effects in Spanish visual word recognition: the role of item imageability. *J Exp Psychol Learn Mem Cogn, 39*(6), 1842-1859. doi:10.1037/a0033090

Wilson, M. A., Ellis, A. W., & Burani, C. (2012). Age-of-acquisition affects word naming in Italian only when stress is irregular. *Acta Psychol (Amst), 139*(3), 417-424. doi:10.1016/j.actpsy.2011.12.012

Woollams, A. M., Taylor, J. R., Karayanidis, F., & Henson, R. N. (2008). Event-related potentials associated with masked priming of test cues reveal multiple potential contributions to recognition memory. *J Cogn Neurosci, 20*(6), 1114-1129. doi:10.1162/jocn.2008.20076
Yamazaki, M., Ellis, A. W., Morrison, C. M., & Ralph, M. A. L. (1997). Two age of acquisition effects in the reading of Japanese Kanji. *British Journal of Psychology, 88*(3), 407-421. doi:10.1111/j.2044-8295.1997.tb02648.x
Yarkoni, T., Balota, D., & Yap, M. (2008). Moving beyond Coltheart's N: a new measure of orthographic similarity. *Psychon Bull Rev, 15*(5), 971-979. doi:10.3758/PBR.15.5.971
Zevin, J. D., & Balota, D. A. (2000). Priming and attentional control of lexical and sublexical pathways during naming. *J Exp Psychol Learn Mem Cogn, 26*(1), 121-135.

TABLES

Table 1. Summary statistics for all the variables used in the lexical decision study

	Mean	Standard Deviation	Minimum	Maximum	Tolerance	VIF
RTs	685.63	73.39	515.54	1286.50		
N-Syllables	2.31	0.909	1.00	6.00	0.41	2.42
OLD20	2.16	0.60	1.00	4.85	0.35	2.79
FreqBooks	27.26	114.25	0.07	4745.47	0.87	1.14
N-size	2.02	3.19	0.00	24	0.41	1.83
Imageability	4.21	1.49	1.31	7.00	0.71	1.39
Subjective Frequency	3.70	1.05	6.45	3.70	0.47	2.08
Conceptual familiarity	83.59	13.44	11.05	98.58	0.43	2.28

Note. RTs, lexical decision latencies; N-Syllables, number of syllables in a word; OLD20, Orthographic Levenshtein distance; FreqBooks, frequency in books; N-size, orthographic neighborhood size.

Table 2. Correlations between all the variables used as predictors (and the dependent variable RTs) in the lexical decision task in Analysis1

	RTs	N-Syllables	OLD20	FreqBooks	N-size	Imageability	Subjective Frequency	Conceptual Familiarity
RTs	1							
N-Syllables	.23**	1						
OLD20	.30**	.72**	1					
FreqBooks	-.17**	-.15**	-.15**	1				
N-size	-.18**	-.51**	-.66**	.22**	1			
Imageability	-.20**	-.31**	-.19**	0.02	.15**	1		
Subjective Frequency	-.57**	.01	-.07**	.27**	.09**	.20**	1	
Conceptual Familiarity	-.51**	.08**	0.00	.11**	0.01	.38**	.69**	1

** Correlations are significant at the 0.01 level (2-tailed).

Note. RTs, lexical decision latencies; N-Syllables, number of syllables in a word; OLD20, Orthographic Levenshtein distance; FreqBooks, frequency in books; N-size, orthographic neighborhood size.

Table 3. Standardized βs, R^2s, and ΔR^2s for the regression analyses

Step		Conceptual familiarity
Step 1	N-Syllables	.09***
	OLD20	.23***
	FreqBooks	.01
	N-size	.08***
	Imageability	-.03*
	Subjective Frequency	-.56***
	R^2	.40
	ΔR^2	.40***
Step 2	Conceptual familiarity	-.28***
	R^2	.44
	ΔR^2	.04***

Note. N-Syllables, number of syllables in a word; OLD20, Orthographic Levenshtein distance; FreqBooks, frequency in books; N-size, orthographic neighborhood size.
The column entitles "Conceptual familiarity" refers to the regression model with conceptual familiarity entered in the last step of the model.
ΔR^2 is the incremental increase in the model R^2 that results from the addition of a predictor or set of predictors in a new step of the model.
*$p < .05$ ** $p < .01$ *** $p < .001$

Table 4. Correlations between all the variables used as predictors (and the dependent variable RTs) in the lexical decision task in Analysis 2

	RTs	Subjective Frequency	Imageability	Conceptual Familiarity	FreqBooks	AoA	old20	N-letters
RTs	1							
Subjective Frequency	-.63**	1						
Imageability	-.25**	.26**	1					
Conceptual Familiarity	-.55**	.69**	.49**	1				
FreqBooks	-.20**	.33**	-0.07	.15**	1			
AoA	.50**	-.62**	-.60**	-.58**	-.22**	1		
old20	0.09	-.15**	0.02	-0.07	-.16**	.18**	1	
N-letters	.19**	-.16**	-.02	-.14**	-.18**	.19**	.37**	1

** Correlations are significant at the 0.01 level (2-tailed).

Note. RTs, lexical decision latencies; N-letters, word length; OLD20, Orthographic Levenshtein distance; FreqBooks, word frequency in books.

Table 5. Standardized βs, R^2s, and ΔR^2s for the regression analyses

Step		Conceptual familiarity
Step 1	Subjective Frequency	-.53***
	Imageability	.01
	FreqBooks	.02
	AoA	.16**
	OLD20	-.04
	N-letters	.10*
	R^2	.43
	ΔR^2	.43***
Step 2	Conceptual familiarity	-.18***
	R^2	.44
	ΔR^2	.01**

Note. N-letters, word length; OLD20, Orthographic Levenshtein distance; FreqBooks, word frequency in books.

The column entitles "Conceptual familiarity" refers to the regression model with conceptual familiarity entered in the last step of the model.

ΔR^2 is the incremental increase in the model R^2 that results from the addition of a predictor or set of predictors in a new step of the model.
*p < .05 ** p < .01 *** p < .001

Appendix

Example of the instructions for ratings for Conceptual familiarity

Familiarité avec le concept

À quel point le concept évoqué par le mot « mot » vous est familier ?

Extrêmement peu familier ——————————————— Extrêmement familier

Vous êtes invité(e) à donner votre estimation sur le degré auquel vous pensez connaitre ou être en contact avec le concept évoqué par un mot.

Par exemple, si vous vous sentez très familier avec le concept qu'évoque le mot « kiwi », et que ça représente pour vous une connaissance très familière, vous défilerez le curseur sur le côté droit de la barre qui indique que c'est un concept extrêmement familier.

Au contraire, si le concept évoqué par un mot vous est moins familier, comme le mot « inukshuk », dans ce cas-là vous défilerez le curseur sur le côté gauche de la barre qui indique que c'est un concept extrêmement peu familier.

Défilez le curseur sur la barre (ou à une de ses extrémités) à l'endroit correspondant le mieux à votre réponse. Par exemple, si vous jugez votre familiarité très forte, vous placerez votre curseur très proche de l'extrémité positive (voire sur celle-ci). Si vous jugez, par contre, que la familiarité est très faible, vous placerez votre curseur très proche de l'extrémité négative (voire sur celle-ci). Si vous estimez qu'elle est moyenne, vous placerez votre curseur aux environs du milieu de la barre, etc.