Feeling affect in a second language

The role of word recognition automaticity*

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Anecdotal evidence from second language users and results from experimental studies indicate that affectively valent words are not always represented identically in a person's first language (L1) and second language (L2) mental lexicons. The present study investigated whether such differences reflect how automatic (immediate, involuntary) the processing is of the *affective* element of affectively valent words, and what the relation is between this kind of processing and general word recognition efficiency for L2 words lacking affective valency. Participants were 48 L1 speakers of English with L2 French. Automaticity of processing adjectives with affective valence was operationalized using an Implicit Affect Association Task (IAAT) developed for this purpose. General efficiency in L2 word recognition was operationalized using a speeded semantic classification task with affectively neutral concrete nouns. Reaction time results from the IAAT showed that the processing of affectively valent words was less automatic in the L2 than in the L1. However, results from the semantic classification task indicated that this effect is not related to general weaker L2 word recognition abilities. Implications for an understanding of the L2 mental lexicon are discussed.

Observers have frequently noted that, for people who speak more than one language, words with affective meanings do not evoke the same "feeling" in their second and other language(s) as do translation equivalents in the first language (L1). For example, English speakers who know French as a second language (L2) may correctly understand *Anne était enragée*; nevertheless this message usually will not have the same psychological "punch" as will the L1 equivalent *Anne was enraged*. Many authors, using a variety of instruments and analytical techniques, have documented such cross-language differences in the way L2 users "feel the affect" in words and expressions that are intended to convey affective meaning (for a comprehensive review, see Pavlenko, 2005). Thus, one can distinguish between

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processing that results in *knowing cognitively* something about the affective valence of a word's meaning (e.g., knowing that the meaning conveys positive or negative affect) and processing that results in *experiencing* something associated with the affective meaning (e.g., a valence response or feeling something related to the positive or negative valence). Most highly functional but not fully fluent L2 users will know that the L2 word for *enraged* has negative valence but they will not necessarily *experience* a negative valence response as compellingly as they do in the L1. The study reported here investigates one factor that may underlie this language difference.

The literature cites many examples of speakers who claim that L2 words often lack the nuances they would like to convey, nuances more precisely communicated in the L1 (see Pavlenko, 2005, and Wierzbicka, 1999, for analyses of subtle cross-language meaning differences). Sometimes, however, the problem is that otherwise appropriate L2 words appear to lack the affective spark felt in corresponding L1 words. For many speakers, such situations can be inconvenient (or worse — annoying and frustrating), especially when they would like to give full expression to deeply felt emotions (e.g., in the heat of an argument; Dewaele, 2006). Beyond being inconvenient, however, such L1-L2 differences can have serious consequences. An obvious example is in health-related communication. People in therapy or undergoing medical examination need to fully understand their health professionals who, in turn, need to understand their patients (e.g., Jacobs, Chen, Karliner, Agger-Gupta, & Sutha, 2006). Moreover, health professionals also need to be able to communicate compassionately (making appropriate use of affective language) with their patients and be understood by them, particularly when providing palliative care, grief counseling, or suicide prevention. Failure to use or respond appropriately to affectively valent words can have significant, even disastrous, consequences for patients in such situations.

A great deal of the research on the processing of emotional and affective language has focused on demonstrating the existence of L1-L2 differences in how L2 users experience such language and in identifying the conditions under which such differences manifest themselves (e.g., Altarriba, 2003, 2006; Altarriba & Bauer, 2004; Anooshian & Hertel, 1994; Dewaele & Pavlenko, 2002; Gonzalez-Reigosa, 1976; Pavlenko, 2002). The present study aimed at investigating whether *the degree of automatic processing of the affective valence of L2 words* might be implicated in such differences. Because most bilinguals do not generally process L2 words as automatically as they do L1 words (Favreau & Segalowitz, 1983; Segalowitz & Hulstijn, 2005), it is possible that they specifically do not experience a valence response to L2 words as automatically. The result would be that such L2 words lack the affective immediacy or impact of their more automatically processed L1 counterparts. In other words, L2 words would not feel as compellingly positive or negative even though their meanings and valence can be correctly recognized. To investigate this language difference in how strongly people register affective valence, the present research focused only on well-known adjectives that can be used to describe people, such as *warm* or *angry*. It did not focus on other types of words that are emotion-laden or that have affective connotations in certain contexts, such as expletives and racial, ethnic or religious epithets because such words are likely to require additional levels of cultural knowledge for proper comprehension.

A major goal of the present research was to measure the degree to which the affective valence of L1 and L2 adjectives *automatically* elicits a response in L2 users. For this, we created a special task — the Implicit Affect Association Task (IAAT), described more fully later. In addition, we used an Animacy Judgment Task to assess the general efficiency of L2 lexical access for concrete nouns, where affective valence was irrelevant. By comparing performance on the two tasks it was possible to see if there is a link between general lexical access proficiency and the more specific processing of affective valence. Before describing these tasks, however, we first discuss the logic of the IAAT more fully.

On an intuitive and informal level, it is easy to see that the following linguistic expressions for describing people all refer to something affectively positive: *generous*, *gentle*, *loyal*, *pleasant*, *virtuous*, *welcoming*, *wise*. Likewise, the sight of a person smiling or laughing will normally evoke, in an immediate way, a mental representation of the situation as having positive affective valence (e.g., that the person just seen is happy at this moment). Thus, encountering either the words or faces leads one to think something positive (e.g., this person is good; this person feels good now; Wierzbicka, 1999). That is, the mental representations evoked by the words *generous*, *gentle*, *loyal*, etc. on the one hand and by the happy/smiling face on the other share underlying positive affective valence. By contrast, the representations evoked by these same words and the sight of a sad or depressed person will evoke representations with different affective valence.

On a more formal and systematic level, Wierzbicka (1999) has written extensively about the subtle similarities and differences existing across languages and cultures in the ways affectively valent and other words are used (see also Goddard & Wierzbicka, 2002; Wierzbicka, 1992, 1996, 1998, 1999, especially pp. 273–307). Wierzbicka and her colleagues have developed a Natural Semantic Metalanguage consisting of some 50–60 semantic primitives (e.g., good, bad, feel, think) for characterizing the meanings of words in different languages and the interpretation of events (e.g., smiling faces) in ways that highlight important similarities and differences in meaning, including affect, across languages and cultures. Others have proposed other ways of capturing the affective content of word meaning. These methods range from linguistic analyses such as those offered by Johnson-Laird and Oatley (1989), to psychological measures of connotative meaning such as Osgood's semantic differential (Osgood, Suci, & Tannenbaum, 1957; used more recently by Koriat, Levy-Sadot, & Edry, 2003), to factor analytic and multi-dimensional scaling analyses (Morgan & Heise, 1988), to word association tasks (e.g., Altarriba, Bauer, & Benvenuto, 1999) and physiological measures (e.g., Harris, Ayçiçeği, & Gleason, 2003; Harris, Gleason, & Ayçiçeği, 2006). For purposes of the present research, however, such formal analyses are not necessary. It is sufficient to acknowledge that, broadly speaking, some expressions used to describe people will include elements of positive affect embedded in their core meanings whereas others will include elements of negative affect. Similarly, the way people encode visually perceived events of someone laughing or crying will include elements of positive or negative affect, respectively, in the representations created at the time of the experience.

The IAAT was designed to quantify the degree of sharing of affective valence by two different categories of stimuli (i.e., pictures, words) embedded within the same block of trials. The basic logic of the task is similar to the Implicit Associations Test used in social psychology (Greenwald, McGhee, & Schwartz, 1998; see also De Houwer, 2001, and De Houwer & Eelen, 1998), with primed lexical decision tasks (Favreau & Segalowitz, 1983; Neely, 1977), with process dissociation tasks (Jacoby, 1991), and with the emotional Stroop task (Sutton, Altarriba, Gianco, & Basnight-Brown, 2007), among others. All these tasks assess automatic processing by revealing the operation of immediate and involuntary processing mechanisms (Ferguson & Bargh, 2003). To illustrate, in one condition of the IAAT used here, participants saw a randomly ordered series of photographs of faces, which they had to categorize as "happy" or "sad" by pressing a reaction time panel. Interleaved with these picture trials were word trials in which they saw written expressions such as "the gentle boy" or "the worried mother" that had to be categorized as "positive" or "negative". In the *incongruent* condition, the participants had to press, as quickly as possible, one reaction time panel for negative expressions on word trials and for happy faces on picture trials, and the other reaction time panel for positive expressions on word trials and for sad faces on picture trials.

It was expected that there would be implicit associations between the positive linguistic expressions and the happy faces and between the negative linguistic expressions and the sad faces. The associations are *implicit* because, from the point of view of the participant, there are no explicitly declared a priori connections between the picture and word trials. The particular stimulus-response mappings just described are, however, *incongruent* because one response is both for stimuli that have positive valence (happy faces) and for stimuli that have negative valence (the negative expressions), and vice versa for the other response. The valence response to the word stimulus was expected to associatively evoke the matching valence response to pictures, thereby giving rise to a competing motor response. The ensuing response selection conflict takes time to resolve, resulting in slower-than-normal reaction times relative to a *neutral* (control) condition. The magnitude of this interference (degree of slowing) provides evidence for the *automatic* nature of these valence responses. The interference indicates that the valence responses to words and pictures interact with each other, evidence of immediate, relatively involuntary (automatic) processing. The participants' intention is to perform as quickly as possible, and the slowing down takes place despite these intentions. To obtain converging evidence that the interference effects in the incongruent condition truly reflect the impact of unintentional processing, a *congruent* condition was included where the stimulus-response mapping was arranged to produce *facilitation* or speeding up of responses relative to the neutral condition. The IAAT was conducted in the both the L1 (English) and the L2 (French) to permit comparison of the automatic nature of affective valence processing across the two languages.

A related hypothesis was that the ability to automatically process the affective valence of word meaning would be related to how efficiently a person is able to recognize word meaning in general (lexical access), with more efficient L2 lexical access being associated with more automatic processing of the affective elements of meaning. To measure the efficiency of general word recognition, we used the Animacy Judgment Task described in Segalowitz and Frenkiel-Fishman (2005). This is a speeded two alternative forced choice task (2AFC) in which participants saw a target expression on the screen (e.g., THE BED) which they had to categorize as quickly as possible as a living or nonliving item. Stimuli were commonly known concrete nouns that referred to living or nonliving objects, and thus provided an independent measure of general lexical access ability.

As in Segalowitz and Frenkiel-Fishman (2005), mean RTs for animacy judgments in L1 and L2 were obtained in separate blocks for each participant. The L2 RTs were then regressed against the L1 RTs and the residuals saved. These residuals provide an *L2-specific* RT measure of lexical access proficiency (speed), that is, the proficiency of lexical access after taking into account individual differences in general cognitive abilities involved in lexical access and in motor response characteristics that would affect RT in the L1 as well. This measure serves as an index of L2 lexical access proficiency that is independent of the IAAT measure insofar as the Animacy Judgment task involves different stimuli (concrete nouns) and a different task (non-affective, animacy judgment).

In summary, the present research was motivated by the following hypotheses. First, it was hypothesized that in both the L1 and L2 conditions of the IAAT, RTs on *in*congruent word trials would be significantly slower than RTs on the congruent word trials, and that response times on neutral trials would be intermediate. This pattern would reflect the operation of interference and facilitation effects due to the way affective elements of meaning were shared across words and pictures implicated in response selection. Second, it was hypothesized that there would be a language by congruency interaction effect, whereby incongruent-neutral difference slopes in the L1 would be steeper (indicating greater departure from performance in the neutral condition) than in the L2, reflecting the stronger and more automatic processing of the affective element of word meaning in the L1 than in the L2. Finally, it was hypothesized that automatic activation of the affective elements of word meaning in the L2 would be associated with proficiency of general L2-specific lexical access, as reflected in residualized measure of speed of L2 word recognition in the Animacy Judgment task.

Method

Participants

The original pool of participants consisted of 53 native speakers of English, L2 speakers of French. After removal of data from 5 outlier participants, as described in the Results section below, the mean age of the final sample of 48 was 25.7 years ($SD = 7.81$, range = 20–54), consisting of 30 females and 18 males. The participants had non-fluent, moderate to high level ability in French as an L2 as determined by a self-report language background questionnaire that included 5-point Likert type scales on abilities in each language, where 1 = *no ability at all* and 5 = *native-like ability*. The overall mean self-rating for speaking English (L1) was 5.0 ($SD = 0$) and for speaking French (L2) was 3.52 ($SD = .77$), $t(47) = 13.28$, $p < .001$. None of the participants was currently studying French as an L2 and all used French as an L2 to a greater or lesser extent in daily activities in Montréal where the research was conducted. All but two of the participants were university students. All reported normal or corrected-to-normal vision and no physical disabilities.

Materials

The animacy judgment task. In each language, the test stimuli for the animacy judgment task were 32 animate and 32 inanimate concrete nouns plus four warm-up animate and four warm-up inanimate nouns (see Appendix A). Words were selected for being likely to be known by moderate (non-fluent) speakers of either language (as confirmed by pilot testing). The English and French words presented to a given participant were never translation equivalents. Nouns were always preceded by a definite or indefinite article (*the/a/an*; *le/la/un/une*) to enhance both the English/French character of the stimuli and the noun interpretation of the English words (out of context, some English nouns can be read as verbs; e.g., *hammer*).

The use of definite and indefinite articles was equated across animate and inanimate nouns. The sequencing of animate and inanimate trials was random with the restriction that successive trial pairs were counterbalanced to prevent response priming or interference biases. Finally, there was also a 72-trial training condition involving simple letter-digit recognition. Stimuli for this task were the digits *2, 3, 4, 5, 6, 7, 8, 9* and the letters *B, F, J, K, H, M, N,* and *P*. This training task familiarized the participants with the speeded 2AFC procedure.

Implicit affective association task (IAAT). The word stimuli used in this study are listed in Appendix B. They are drawn from two categories of items: 16 English adjectives that normally have affective positive valence and 16 English adjectives that normally have negative affective valence. These adjectives were combined with the nouns to form noun phrases such as *a tiresome boy* and *a gentle child*. From these word lists, two subsets of eight positive and eight negative noun phrases were created in each language making it possible to present to a given participant expressions in English and in French without using adjectives that were translation equivalents. The L2 words were chosen on the basis that they would be well known to moderate speakers of French, as confirmed by pilot testing. The English words were matched, as translation or near-translation equivalents or similar category words.

Picture stimuli. There were three categories of picture stimuli: 16 color pictures of happy and sad, ethnically diverse faces — with male/female and old/young faces fully counterbalanced across the happy and sad subsets; 16 pictures of readily recognizable whole and broken objects — cup, eye glasses, cell phone, pencils, with two whole and two broken exemplars of each; 16 pictures of food and tools — two exemplars each of apple, banana, celery, onion, and hammer, pliers, saw, and vise grip. The two exemplars of a given object differed in terms of the vantage point from which the photo was taken and, in the case of broken objects, the arrangement of the pieces.

The picture and word stimuli were combined into three English and three French sets as follows. *Faces-Word set*: Each set consisted of eight happy and eight sad faces in a random sequence alternating with eight positive and eight negative expressions in a quasi-random manner to produce a sequence of 32 items. The sequencing was such that pictures of happy and sad faces preceded positive and negative expressions equally often. *Objects-Word set*: A similar 32-item picture-word sequence was constructed using the pictures of eight whole and eight broken objects with eight positive and eight negative expressions. *Neutral Picture-Word set*: Finally, a similar 32-item picture-word sequence was constructed using the pictures of eight food and eight tools with eight positive and eight negative expressions. Pictures of foods and tools preceded positive and negative expressions equally often. The first five trials (three picture and two word trials) in each set served as warm-up trials, leaving 14 experimental word trials.

Design

The IAAT part of the study conformed to a 3 × 2 factorial design with the factors being Congruency (congruent, incongruent, neutral) and Language (L1 [English], L2 [French]), with each condition occurring as a separate block of trials. For all participants, the neutral condition involved the Neutral Picture-Word set. For half the participants, the congruent condition involved the Faces-Word set and the incongruent condition involved Objects-Word set, whereas for the other half the sets were reversed. The design of the Animacy Judgment Task conformed to a simple 2-factor design (L1 vs. L2) with separate blocks of trials for each language.

Apparatus

Stimuli were presented on a Macintosh G4 iBook with a 15-inch screen. The response panel was a numeric keypad. The experiment was programmed in PsyScope, V.1.2.5 PPC (Cohen, MacWhinney, Flatt, & Provost, 1993).

Procedure

The participants first completed a demographic and language background questionnaire and then performed two computer tasks: the Animacy Judgment Task and the Implicit Affect Association Task. The session lasted from 45 to 60 minutes and participants were either paid or given partial course credit for their collaboration. The general testing procedure was as follows. Each participant performed the various tests in two separate language blocks, either L1 followed by L2 or the reverse, counterbalanced across participants, and always in the same order across conditions for a given participant. The tasks were administered as follows.

First, participants did the three parts of the Animacy Judgment Task in the following order: training trials (letter-digit identification); animacy judgment test trials in English (or French); animacy judgment test trials in French (or English). Each part consisted of a speeded two-alternative forced choice (2AFC) task in which participants had to judge whether a stimulus belonged to one category or another. In the training part, they had to decide if the stimulus presented on the computer screen was a digit or a letter by pressing the left or right key respectively, using the index fingers of each hand. There were 72 training block trials. In the test trials they had to judge whether an article-noun stimulus (e.g., THE BED) referred to something living or nonliving by pressing the right or left key respectively. There were eight warm-up trials and 64 randomly ordered test trials in each test block. Participants were instructed to respond as quickly as possible without sacrificing accuracy. Deadline to respond was 3000 ms. When the participant made an error, the computer generated an audible feedback signal and there was a 450 ms delay inserted before the onset of the next trial.

Next, participants did the different parts of the Implicit Affect Association Task as follows. To avoid additional cognitive challenges that would be introduced by language shifts, they did all the neutral, congruent and incongruent conditions in one language and then the three conditions again in the other language. The sequence of events within a language block was the following: familiarization by reading a printed set of the word stimuli, followed by a block of word training trials, followed by the neutral condition, followed by the congruent and incongruent conditions, with the order of the latter two counterbalanced across participants. Word training consisted of 32 randomly ordered speeded-2AFC trials with the word stimuli only, to train participants on which hand to use for the positive and negative responses. For each of the neutral, congruent and incongruent conditions, the sequence was first a training block of 32 trials with pictures only, followed by a test block of 32 trials with alternating picture/word stimuli (all trials

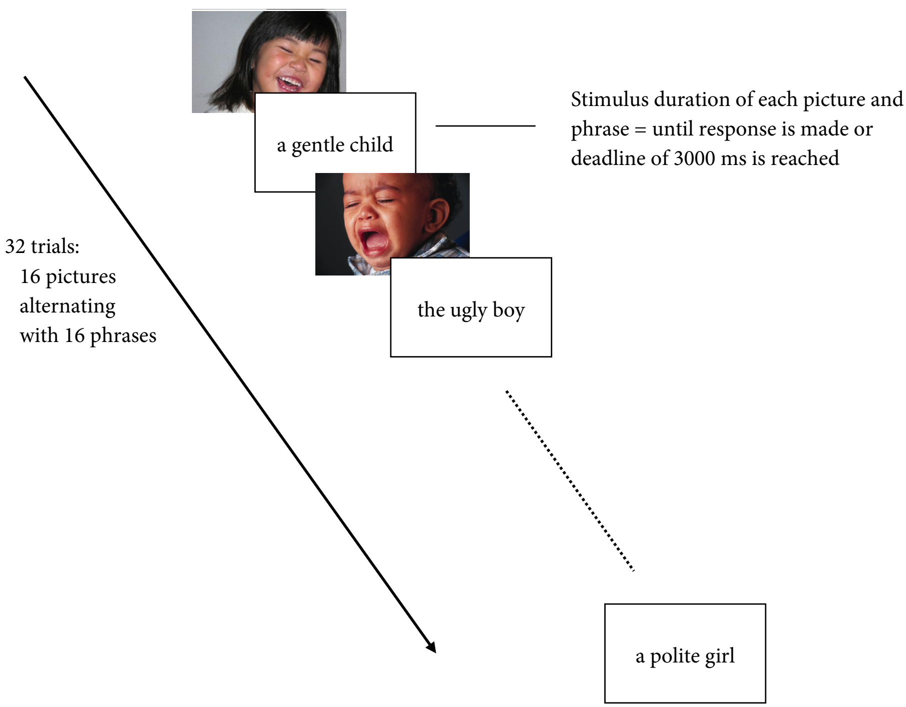

Figure 1. Sequence of presentations in one block (in one language only) of the Implicit Affect Association Task.

randomly ordered). The first five trials (picture-word-picture-word-picture) were warm-up trials. Figure 1 shows the sequence of stimulus presentation for a given test condition. Participants were instructed to respond as quickly as possible without sacrificing accuracy. A new stimulus came up for the next trial as soon as the participant responded. Deadline to respond was 3000 ms. A computer-generated audible feedback signal was given after every trial to indicate whether the response was correct or incorrect.

On each test trial, the participants responded to a picture (e.g., a sad face) and then to a noun phrase (e.g., *a gentle child*) on alternating picture/word trials. On picture trials, they had to press a reaction time key to classify the item shown (happy/sad face; whole/broken object; tool/food). On word trials, they had to judge whether the noun phrase referred to something positive or negative. On word trials in all conditions, half the participants had to press the right panel on positive trials and the left panel on negative trials, and the reverse for the other participants. On picture trials in the *congruent* condition, they responded by pressing the same panel for happy faces (or whole objects) as for positive noun phrases and the other panel for sad faces (or broken objects), the same as for negative noun phrases. In contrast, on *incongruent* trials, they responded by pressing the same panel for whole objects (or happy faces) as for negative noun phrases and the other panel for broken objects (or sad faces), the same as for positive noun phrases. On neutral trials, they responded by pressing one panel for food items and the other for tool items (counterbalanced across participants).

Results

The alpha level for significance was set at .05. Unless otherwise indicated, all tests were two-tailed, and for all analyses, $N = 48$. Only data from correct trials were submitted to analysis. The RT data for each participant were first winsorized to reduce the impact of extreme fast or slow responses in a given condition. For this, in each sub-condition, the fastest and slowest 10% of a participant's RTs on correct trials were replaced with next closest RT.

Of the 53 participants recruited, five yielded outlier RTs indicating *facilitation* in the incongruent condition relative to the congruent condition of the IAAT and so their data were removed from subsequent analyses, leaving a sample of 48. Finally, inspection of the data revealed no differences in RTs between the older and younger participants.

Implicit Affect Association Task

The mean RTs and standard deviations from the IAAT condition for correct responses on word trials are presented in Table 1 for each sub-condition, along with accuracy (percent correct). The data for picture trials are also reported in Table 1 for completeness, but they were not further analyzed statistically, as only the word trial data were relevant to the hypotheses motivating this research.

Inspection of the accuracy data (percent correct) showed that performance levels were high, and that participants had no difficulty classifying the word or picture stimuli correctly. The accuracy data for word stimuli were submitted to a 2×3 repeated measures analysis of variance (ANOVA) with the factors being Language (L1, L2) and Congruency (congruent, incongruent, neutral) in order to determine whether there were any differences in accuracy by condition. The only significant effect was for congruency, $F(1, 47) = 4.72$, $p < .04$, partial $\eta^2 = .092$, indicating that accuracy was slightly worse in the incongruent condition (93.5%) than in the other two conditions (95.4%, 95.0%). These differences, however, were not considered meaningful.

The RTs for correct trials were submitted to a 2×3 repeated measures ANOVA with the factors being Language (L1, L2) and Congruency (congruent, incongruent, neutral). The analysis yielded a significant language effect, $F(1, 47) = 12.90$, $MSE = 62{,}758.758$, $p < .001$, partial $\eta^2 = .215$, reflecting the faster RTs in L1 than in L2. There was also a significant linear, $F(1, 47) = 127.428$, $MSE = 91{,}850.455$, $p < .001$, partial $\eta^2 = .731$, and a significant quadratic, $F(1, 47) = 22.46$, $MSE = 47{,}777.988$, $p < .001$, partial $\eta^2 = .323$, effect for congruency, reflecting the generally fastest RTs

Table 1. Mean reaction times (RT), standard deviations (SD) and accuracy as percent correct in the six word and six picture conditions of the implicit affect association task

Language Condition	**L1 (English)**			**L2 (French)**		
	RT (ms)	(*SD*)	*%Correct*	RT (ms)	(*SD*)	*%Correct*
Implicit Affect Association Task Condition						
Word Trials						
Neutral	992	(235.57)	95.0	1151	(337.58)	95.1
Congruent	903	(204.02)	97.1	1006	(205.33)	93.6
Congruency effect	89			145		
Incongruent	1421	(413.76)	93.9	1476	(455.46)	93.1
Incongruency effect	429			325		
Picture Trials						
Neutral	604	(69.85)	97.3	610	(90.68)	97.7
Congruent	768	(102.26)	95.5	787	(112.65)	95.4
Incongruent	791	(140.79)	96.1	774	(109.52)	95.3

for congruent trials, intermediate RTs for neutral trials and slowest RTs for incongruent trials. There was a significant quadratic interaction effect between language and congruency, $F(1, 47) = 8.09$, $MSE = 12{,}552.321$, $p = .007$, partial $\eta^2 = .147$. This last result indicates that the relationship between the three congruency conditions was different for the L1 and the L2. This interaction is explored next.

The main hypotheses concerned the relationship between performance on the incongruent trials relative to the neutral trials, and performance on the congruent trials relative to the neutral trials. For this reason, the data were resubmitted to two separate 2 × 2 repeated measures follow-up ANOVAs.

The first follow-up analysis examined performance on the incongruent trials relative to the baseline neutral trials. The factors were Language (L1, L2) and Congruency (incongruent, neutral). The analysis yielded a significant language effect, $F(1, 47) = 6.91$, $MSE = 79{,}815.057$, $p < .02$, partial $\eta^2 = .128$, reflecting faster RTs in L1 than in L2. There was also a significant congruency effect, $F(1,47) = 91.78$, $MSe = 74{,}098.031$, $p < .001$, partial $\eta^2 = .661$, reflecting slower RTs in the incongruent condition than in the neutral condition. Finally, there was a significant interaction effect between language and congruency, $F(1,47) = 5.33$, $MSE = 24{,}351.106$, $p = .03$, partial $\eta^2 = .102$, indicating a greater incongruent-neutral difference in the L1 (English) (428 ms) than in the L2 (French) (324 ms).

Because this interaction was an underadditive effect (i.e., there was *smaller* RT difference in the more difficult L2 condition), the data were further analyzed to explore a possible alternative interpretation of the results to reduced automatic processing. It is theoretically possible that the smaller incongruent-neutral difference in the L2 reflected some amount of parallel processing in which the response selection conflict associated with the incongruent condition was partially resolved in parallel with the ongoing slow processing of the L2 stimulus. Such parallel processing could mask the true extent of the time needed to resolve this conflict. This could mean that, compared to the L1 condition, less of the observed total RT in the L2 condition is actually spent on resolving the interference caused by the incongruency, thereby posing a challenge to the automatic processing explanation.

One way to examine whether this concern applies to the present data is to compare the pattern of results between faster and slower responders in the L2 condition. If the underadditive effect truly reflects parallel processing rather than weaker interference from the response selection conflict, then the slower responders should show a greater underadditive effect than the faster responders in the L2 because the former would presumably need more time to resolve the response conflict than the latter. For this analysis, the participants were divided into three equal groups ($n = 16$ in each subgroup), with an analysis done to compare the fastest against the slowest subgroup to maximize the contrast, based on RTs in the neutral condition, because these RTs reflected basic processing time for the stimuli in the absence of an incongruity effect. This analysis yielded the following mean L2 RTs: Slow responders: neutral = 1535 ms (*SD* = 312.07); incongruent = 1916 (*SD* = 501.83); Fast responders: neutral = 881 ms (*SD* = 77.53); incongruent = 1234 ms (*SD* = 199.52). That is, the slow responders showed, if anything, a *greater* L2 incongruity effect (incongruent-neutral difference), and therefore, a *smaller* underadditive effect, than the fast responders (381 vs. 353 ms, respectively, *n.s.*), a difference in the opposite direction from that expected under a parallel processing interpretation of the original interaction effect. This result strengthens the interpretation of the language by congruency interaction given earlier, namely, that there was a weaker interference effect in the L2 compared to the L1, and not more parallel processing to overcome the interference effect during the slower processing of the L2 word stimuli.

The second follow-up analysis examined performance on the congruent trials relative to the baseline neutral trials. The factors were Language (L1, L2) and Congruency (congruent, neutral). The analysis yielded a significant language effect, $F(1, 47) = 28.24$, $MSE = 29{,}368.247$, $p < .001$, partial $\eta^2 = .375$, again reflecting the faster RTs in L1 than in L2. There was a significant congruency effect, $F(1,47) = 15.21$, $MSE = 43{,}494.177$, $p < .001$, partial $\eta^2 = .245$, reflecting the faster RTs in the congruent condition than in the neutral condition. There were no other significant effects.

Animacy Judgment Task

Mean RTs, coefficients of variation (*CV*) (discussed in detail below) and percent error (*PE*), and their corresponding standard deviations (*SD*) for correct trials from the animacy judgment are presented in Table 2. RTs in L1 (English) were significantly faster than in L2 (French), $t(47) = -8.042$, $p < .001$, and the *CV*s in English were significantly smaller than in French, $t(47) = -3.311$, $p < .003$, indicating L1 dominance insofar as lexical access time in the L1 was both faster and more stable than in the L2, as expected. L1 and L2 RTs correlated significantly with each other ($r = .688$, $p < .0001$) indicating that over 47% of the variance in the L2 RTs was accounted for by variance in the L1 RTs. To obtain an RT measure for each participant that was specific to L2 performance, the L2 RTs were regressed against

Table 2. Mean reaction times (RT), intra-individual coefficient of variation (*CV*), the corresponding standard deviations (*SD*), and percent error (*PE*) for performance in the English (L1) and French (L2) conditions of the animacy judgment task.

Language Condition	**RT (ms)**	(*SD*)	*CV*	(*SD*)	*PE*
L1 (English)	739	(105)	.202	(.069)	2.75
L2 (French)	851	(131)	.235	(.062)	7.16

the L1 RTs and the residuals saved as L2-specific RTs. Likewise, L1 and L2 *CV*s correlated significantly with each other ($r = .429$, $p < .003$) and residualized L2-specific *CV*s were similarly calculated for each participant. These L2-specific measures of general lexical access ability were used in the analyses reported below.

Relation between affectively valent word processing and general lexical access proficiency

The next step investigated whether individual differences in lexical access proficiency, as reflected in the L2-specific residualized RT measures obtained in the animacy judgment task, were related to the automaticity of processing affectively valent L2 words, as reflected in the interference effects observed in the incongruent condition of the IAAT. Two correlations were computed, each with the L2-specific RT measure of lexical access proficiency as one of the two variables. The first correlation was with the L1-L2 differences in the size of the incongruency effects. This correlation was not statistically different from zero ($r = -.24$, *n.s.*), indicating that the greater automaticity of processing L1 word stimuli than L2 word stimuli in the IAAT was not related to general speed of L2 word recognition. This result failed to support the hypothesis that L2 general proficiency in word recognition speed accounts for the relative degree of automaticity in L2 affective word processing compared to the L1. A correlation conducted with the L2 (French) incongruity effect considered alone (as opposed to the L1-L2 differences in the effect) likewise yielded a nonsignificant result ($r = .23$, *n.s.*), again failing to support the hypothesis.

Segalowitz and Segalowitz (1993) (see also Segalowitz & Hulstijn, 2005) argued that whereas more efficient lexical access is likely in most cases to result in faster performance on a lexical access task, faster performance does not necessarily indicate more efficient lexical access. Individuals can differ in simple speed of processing without differing in how efficiently underlying processes are organized, but people whose underlying processes are more efficiently organized will respond faster. To disentangle speed from efficiency in performance on speeded tasks, Segalowitz and Segalowitz proposed that under certain circumstances a measure of RT *stability* provides a better index of processing efficiency than does the RT itself. An appropriate measure of RT stability to use in this case is a measure of intra-individual variability in RT, namely the coefficient of variation (*CV*) of a person's RT (the *SD* of RT divided by the mean RT for that individual). (See Wagenmakers & Brown, 2007, for discussion of the relationship between RT and the *CV* of RT. Also, see Hultsch, MacDonald, & Dixon, 2002, for related research using other measures of intra-individual RT variability in studies of individual differences in processing efficiency.) The lower an individual's *CV* value (that is, the smaller the

SD per ms of RT), the more stable are the person's response times and hence more efficient (less "noisy") the processing.

Given the non-significant correlations reported earlier with the RT measure of L2-specific lexical access proficiency, the *CV* measures obtained from the animacy judgment task were used as another index of L2 processing ability (see Table 2). These L2 *CV* measures were residualized against the L1 measures to yield an L2-specific *CV* measure of lexical access efficiency. A correlation was first calculated between the L2-specific RTs and L2-specific *CV*s (see Segalowitz & Hulstijn, 2005) to determine whether individual differences in lexical access processing speed were related to processing efficiency (and not simply to faster overall processing). This correlation was significant, $r = .565$, $p < .001$, indicating that faster responders in the L2 were indeed more stable responders, even after taking into account performance in the L1, and hence the *CV* measure could be used as an index of processing efficiency.

The L2-specific *CV* measure was then correlated with the L1-L2 differences in the size of the incongruency effect. This correlation was non-significant ($r = -.09$, *n.s.*), indicating that the degree of automaticity of processing the L2 stimuli in the IAAT was not related to the level of general efficiency in processing L2 words. This result again failed to support the hypothesis that L2 general processing ability in word recognition accounts for the L1-L2 difference in degree of automaticity in L2 processing of affective stimuli in the IAAT. Next, a correlation was computed between the L2-specific *CV* measure and the incongruity effect in the L2 (French) considered alone. This correlation was statistically significant and in a positive direction ($r = .457$, $p < .002$), indicating — somewhat counter intuitively and certainly counter to the original hypothesis — that *less efficient* general L2 lexical access (larger L2-specific *CV*) was associated with *more automatic* processing of the affective word stimuli in the IAAT (greater incongruency effect). A follow-up correlation between the L2-specific *CV* measure and the magnitude of the L1 (English) incongruity effect considered alone also yielded a significant result ($r = .306$, $p < .04$). This result was also unexpected because it indicated that more efficient lexical access *in the L2* was associated with less automatic processing (smaller incongruency effects) *in the L1*.

Discussion

The results obtained in the IAAT supported the main hypothesis that processing affectively valent words in the L1 is automatic, at least in part, and that to the extent that it was also automatic in the L2 in these L1-dominant bilinguals, the automaticity was greater in the L1 than in the L2. The L1 results also confirmed the suitability of the IAAT for investigating how L2 users process affectively valent words. The results supporting these conclusions are now discussed in turn, followed by consideration of their implications for models of the bilingual lexicon.

The first important result concerns the use of the IAAT to study the processing of affectively valent words. As expected, the participants' response times on L1 word trials were slowest in the incongruent condition (the interference effect relative to the neutral condition), fastest in the congruent condition (the facilitation effect relative to the neutral condition), and intermediate in the neutral condition (baseline). The interference and facilitation effects were large, being 428 ms and 89 ms respectively. Together, these L1 effects provide a basic demonstration that the IAAT methodology is sensitive to the processing of affective information and allows for a fine-grained behavioural on-line index (RT) of the automatic nature of this processing. In terms of the processes involved, the results are consistent with the idea that affectively valent words and pictures of happy/sad faces and whole/broken objects can give rise to implicit associations based on underlying affective elements. In the context of the IAAT, these shared elements became associated with response selection options (pressing the right or left key), resulting in facilitation or interference depending on the condition.

The second important result speaks directly to the main hypothesis regarding the impact of the affectively valent word stimuli *in the L2*. The data showed that in the incongruent condition there was a large L2 interference effect (324 ms), confirming the sensitivity of the IAAT to the affective valency of the stimuli. Moreover, this L2 interference effect was significantly smaller (by 104 ms) than the corresponding L1 interference effect indicating that, despite being able to accurately process affective valency, the participants were less automatic at doing so in the L2 than in the L1.

Both the L1 and L2 interference effects observed here indicate that *automatic* mechanisms underlie, in part at least, the processing of affective valence information. Only the operation of some immediate and relatively involuntary processes could be responsible for the interference effects obtained, given that the participants had no strategic reason to intentionally slow their responses in the incongruent condition but not in the other conditions. A similar case could be made for the facilitation effects in the congruent condition, but the argument is more compelling for the incongruent condition because the interference effects occurred *despite* the participants' effort to perform as rapidly as possible. Given that the interference effects were weaker in the L2 (coupled with the finding that this was not related to the generally slower processing in the L2) one is led to the conclusion that processing of a word's affective valence was less automatic in the L2. This result is consistent with general assumptions about L2 processing in L1-dominant bilinguals (that L2 words are processed less automatically), and is consistent with the findings of Favreau and Segalowitz (1983) that even in highly skilled L2 readers, word recognition tends to be less automatic (ballistic) in the L2 than in the L1 (but see the discussion in the next paragraph). The present finding is consistent too with the idea that the affective valence of L2 words is *experienced* in a less immediate way (perhaps because of the reduced automaticity), as was proposed at the beginning of this report.

Now, on the one hand, the finding here of weaker automatic processing of L2 words with affective valence is consistent with previous findings of reduced automaticity in L2 word processing. On the other hand, some aspects of the findings pose a challenge. The present study included speed and efficiency measures of L2-specific lexical access for reading simple concrete nouns (general vocabulary). It was hypothesized that the more the L2 lexical access skills resembled those of L1, the less the L1 would dominate the L2 in terms of automatic processing of affectively valent words. This result was not obtained; the correlation was near zero. Thus, whereas the processing of affectively valent words was more automatic in the L1 than in the L2, there appears to be no necessary link between this and a person's general ability in L2 word processing. On the contrary, the finding indicates the possibility that processing the affective valence of words is a skill separate from general word recognition. Put another way, affectively valent L2 words and general vocabulary may each start out being processed less automatically than corresponding words in the L1, but each can have its own developmental trajectory, and the gap between the L1 and L2 in the processing of affectively valent words need not parallel the gap in the processing of other words. This raises important questions about what kinds of experiences, then, will lead to the automatization of processing L2 affective information. The present study did not address this question, but it would appear that the IAAT might be a useful instrument to use in future research on this topic.

The present study yielded another interesting result that may have implications for an understanding about the bilingual mental lexicon. The results so far appear to be compatible with models of the developing bilingual mental lexicon that claim that the links between L2 words and their underlying conceptual representations are weaker than for L1 words, or that hold that L2 words are linked to an underlying conceptual representation via translation through the L1 (e.g., the Revised Hierarchical Model; Kroll & Stewart, 1994). In the present study, it was expected that the automaticity of processing affectively valent L2 words would be related to their L2 lexical access abilities in general. The data did not support this view. Measures of L2-specific speed of general lexical access were unrelated to the automaticity of processing affectively valent L2 words. Moreover, a measure of efficiency of L2 lexical access (in contrast to speed of access) did yield a significant relationship, but one in the opposite direction to that expected. Second language users with superior L2 lexical access abilities (as reflected by the L2-specific *CV* measure of lexical access efficiency) showed *weaker* L2 interference effects (less automaticity) in the incongruent condition. This result is not consistent with at least two possibilities about the organization of the L2 mental lexicon. First, it is not consistent with the idea that L2 lexical access proficiency develops by strengthening L2-L1 translation links (indeed, most current models of the L2 mental lexicon also reject this idea; for reviews see Dijkstra, 2005; Kroll & Tokowicz, 2005; Thomas & Van Heuven, 2005). This is because stronger L1-L2 links should result in more, not less, automaticity effects. However, the results are also not consistent with the idea that, as direct links between L2 words and their underlying conceptual representations become stronger, cross language links become correspondingly weaker (as is proposed in the Revised Hierarchical Model; Kroll & Stewart, 1994). Again, stronger L2-concept links with weakened L1-L2 links should also result in more, not less, automaticity effects, the opposite of what was found.

The present study also found that the measure of L2-specific processing efficiency correlated positively with interference effects *in the L1*. This was surprising, because one would not expect a priori that the automaticity of processing affectively valent L1 words would be influenced by a person's L2 proficiency. Nevertheless, this result can perhaps be reconciled in terms of current models of the bilingual lexicon (Dijkstra, 2005; Kroll & Tokowicz, 2005; Thomas & Van Heuven, 2005). Many studies using priming, lexical decision and word association techniques have found evidence that the lexicon in L2 users is integrated across the L1 and L2 as proficiency develops. Van Hell and Dijkstra (2002), for example, conducted a study involving word association and lexical decision with multilinguals who had different degrees of fluency in their L1, L2 and L3. The pattern of responses in the L1, as a function of how the L1 words were related to corresponding words in the L2 and L3 and to how fluent the participants were in these languages, led to the conclusion that "the language processing system of multilinguals is profoundly nonselective with respect to language" (p. 786). Dijkstra (2005) and Dong, Gui, and MacWhinney (2005) came to similar conclusions. The upshot of this is that the greater a person's proficiency in the L2, the more one can expect there to be some kind of integration of the lexicon across languages.

Such integration might underlie the unexpected association between greater L2 lexical access proficiency with smaller interference effects in the IAAT. When words are encountered, presumably both language-based representations (e.g., information about phonology, grammatical features of the word, and associations with other words) and general-conceptual representations (features of meaning that are not necessarily language based) are activated. These together comprise the overall meaning representation of the word. When the L1 and L2 lexicons are highly integrated, the result is a representation for the encountered word that is larger and richer overall than when the L1 and L2 lexicons are much less integrated. This richer representation is, in turn, highly distinguishable from the partially overlapping representations activated by picture stimuli. By contrast, when the L1 and L2 lexicons are not highly integrated, the result is a representation that is less rich overall and hence less distinguishable from partially overlapping picture-activated representations. The result is that in L2 users with more fully integrated lexicons — those who are more proficient in the L2 — there will be less overall similarity between the representations activated on word trials than on picture trials, and consequently less competition leading to response selection interference, and hence weaker incongruity effects.

For example, the L1 stimulus "a guilty mother" presumably activates a number of general conceptual elements that underlie its meaning, including elements referring to the presence of something bad. These elements make "guilty" a negative expression (see, e.g., Wierzbicka, 1999, p. 121, for an analysis of "guilty"). A picture of a sad face will activate these and related elements that refer to something bad because these are inherent in the meaning of sad (see, for example, Wierzbicka, 1996, p. 180). Conflicting left-right panel press responses are associated with these shared elements, giving rise to the interference effect observed in the incongruent condition. However, in L2 users with a highly integrated mental lexicon, the L1 expression will have multiple connections to the L2 words (and vice versa) and therefore the underlying L1 representation will also be richer than it would be otherwise, and hence more distinguishable from a corresponding picture-activated representation. This distinctiveness makes it easier to overcome any stimulus-response interference that might arise, resulting in a weaker incongruity effect in the L1. However, interference effects will nevertheless be observed, because some response selection conflict still exists. Moreover, the L1-L2 *difference* in the size of the interference effect will not necessarily vary with L2 proficiency, because both L1 and L2 words will be affected in the same general way. What does change is that the L2 user with the more fully integrated lexicon will show weaker interference effects overall, and in both language conditions.

Summary and conclusions

The present study yielded three important results about the nature of cross-language differences in the processing of affectively valent words. First, as hypothesized, the incongruity effect for affectively valent words was significantly weaker in the L2 than in the L1. This incongruity effect stemmed from making judgments about pictures of happy and sad faces under conditions that gave rise to immediate and relatively involuntary interference with response selection on word trials.

Because happy and sad faces can be considered to be basic emotional stimuli (Ekman, 1992; Wierzbicka, 1999, Chapter 4), this outcome supports the idea that processing affect in word meaning is itself automatic, and in these participants, it was automatic (to some extent at least) in both their languages. This interference arising from this automatic processing served here as an operational definition of the "psychological impact" of affectively valent words on the participants. Thus, the first conclusion is that cross-language differences in feeling the affect expressed by words rests, in part at least, on differences with which these words are processed automatically in the L1 and L2, and that *in the L2, the processing of affect is less automatic*.

The second important finding is that the result just described was not itself directly associated with how proficient the L2 users were in processing L2 word meaning in general. The relevant evidence for this is the near-zero correlation between the magnitude of the word/picture interference effects in the L2 and L2-specific measures of word recognition skills for general vocabulary. This result is interesting because it suggests that the ability to process general vocabulary does not necessarily carry with it a corresponding ability to process affectively valent words and that therefore the ability to process affectively valent words is a special skill, separate from general vocabulary skills. Perhaps to acquire a high level of proficiency in processing words with affective valence one needs direct, personal experiences in which the affective content of words are genuinely "felt" during real communicative exchanges. Simply encountering words in print or in casual conversation may not be sufficient for such words to acquire full affective impact. Pavlenko (2005, p.142; see Koven, 2006) alludes to this possibility in a discussion about a fluent L2 speaker of Portuguese whose "anger repertoire lacks richness and sophistication because her peer socialization — and thus arguing, fighting and quarreling — took place mainly in French". The present results suggest that if instructed language acquisition is to address the problem of developing sensitivity to the affective dimensions of word meaning, it will be important to focus on automatizing the processing of affect in the L2 in social, genuinely communicative, and highly contextualized environments (see Gatbonton & Segalowitz, 2005).

The final result was the unexpected finding that the interference effect in the L1 (and in the L2 as well) *decreased* with increasing levels of L2 proficiency. This result was interpreted in terms of the increasing integration of the L1 and L2 lexicons as the L2 user becomes more proficient. The implication is that the L1, by being embedded in a more integrated lexicon, functions differently than before (see, for example, Cook, 2003; Pavlenko, 2003). Future research could explore this further, using an implicit affect association task like the one used here, to document subtle but real changes in the L1 resulting from increasing mastery of the L2. The result of such research could broaden considerably our understanding of the way the L1 and L2 lexicons interact and how that interaction changes as a function of different kinds of acquisition experience.

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Appendix A. Stimuli used in the animacy judgment task for assessing efficiency of lexical access

English Test: *aunt, baby, bee, boy, cow, daughter, eagle, fish, flower, fox, frog, gentleman, goat, guest, horse, knight, lady, lobster, manager, mosquito, parrot, person, pig, sheep, sister, son, spider, spouse, squirrel, tourist, trout, woman; bag, bed, bench, boat, car, chair church, closet, cotton, cup, door, exit, fence, floor, football, fork, hammer, hat, key, knife, plastic, road, rope, rug, school, skirt, soap, sock, tool, violin, watch, window*

English Warm-up: *camel, monkey, musician, queen; ceiling, lock, nail, store*

French Test: *âne* 'donkey', *canard* 'duck', *chat* 'cat', *chien* 'dog', *copain* 'friend', *coq* 'rooster', *cygne* 'swan', *enfant* 'child', *étudiant* 'student', *fourmi* 'ant', *frère* 'brother' *grand-père* 'grandfather', *homme* 'man', *infirmière* 'nurse', *insecte* 'insect', *lapin* 'rabbit', *loup* 'wolf', *mère* 'mother', *neveu* 'nephew', *oiseau* 'bird', *oncle* 'uncle', *ours* 'bear', *papillon* 'butterfly', *père* 'father', *poule* 'hen', *professeur* 'teacher', *roi* 'king', *rouge-gorge* 'robin', *saumon* 'salmon', *tigre* 'tiger', *tortue* 'turtle', *ver* 'worm'; *aéroport* 'airport', *assiette* 'plate', *auberge* 'inn', *avion* 'airplane', *banque* 'bank', *boisson* 'drink', *bouilloire* 'kettle', *bouton* 'button', *canot* 'canoe', *ceinture* 'belt', *chandail* 'sweater', *chemise* 'shirt', *chocolat* 'chocolate', *colline* 'hill', *cravate* 'tie', *cuillère* 'spoon', cuisine 'kitchen', *entrée* 'entrance', *horloge* 'clock', *jouet* 'toy', *lait* 'milk', *manteau* 'coat', *métro* 'subway', *mouchoir* 'handkerchief', *pneu* 'tire', *poche* 'pocket', *poêle* 'stove', *porcelaine* 'china', *ruban* 'tape', *serviette* 'napkin', *timbre* 'stamp', *verre* 'glass'

French warm-up: *acteur* 'actor', *crabe* 'crab', *débutant* 'beginner', *mouche* 'fly'; *bol* 'bowl', *cahier* 'notebook', *gâteau* 'cake', *sable* 'sand'

Appendix B. Word stimuli with positive and negative valence used in the implicit affect association task.

English

positive: *brave, careful, generous, gentle, kind, likeable, lively, loyal, open, pleasant, polite, proud, virtuous, warm, welcoming, wise*

negative: *annoying, cold, disgusting, evil, guilty, hateful, insane, irritated, noisy, selfish, shameful, sick, stubborn, tiresome, ugly, worried*

French (with masculine/feminine endings shown where needed)

positive: *accueillant* (-*e*) 'welcoming', *agréable* 'pleasant', *aimable* 'friendly', *attentif* (-*ve*) 'careful', *chaleureux* (-*se*) 'warm', *courageux* (-*se*) 'brave', *doux* (-*ce*) 'sweet', *fidèle* 'loyal', *fier* (-*ère*) 'proud', *généreux* (-*se*) 'generous', *gentil* (-*le*) 'kind', *ouvert* (-*e*) 'open', *poli* (-*e*) 'polite', *sage* 'wise', *vertueux* (-*se*) 'virtuous', *vivant* (-*e*) 'lively'

negative: *bruyant* (-*e*) 'noisy', *coupable* 'guilty', *dégoûtant* (-*e*) 'disgusting', *égoïste* 'selfish', *énervé* (-*e*) 'anxious, agitated', *ennuyeux* (-*se*) 'boring', *fou* (*folle*) 'insane', *froid* (-*e*) 'cold', *honteux* (-*se*) 'shameful', *inquièt* (-*e*) 'worried', *laid* (-*e*) 'ugly', *malade* 'sick', *méchant* (-*e*) 'mean', *odieux* (-*se*) 'obnoxious', *pénible* 'tiresome', *têtu* (-*e*) 'stubborn'.

Nouns used in combination with the adjectives (English/French):

boy/garçon, *child/enfant*, *father/père*, *girl/fille*, *man/homme*, *mother/mère*, *person/personne*, *woman/femme*