The Language of Pain in the Bilingual Lexicon

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ABSTRACT

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This research addresses the question of how the semantic understanding of a set of pain words in French and English differs in a second language (L2) compared to a first language (L1) as a function of level of proficiency. Participants were 32 French-English bilinguals who were native-speakers of one of those languages and speak the other as a L2. The data were collected through two main sets of tasks. The first addressed language experience and proficiency, using subjective and objective measures. The second addressed semantic understanding of the words in French and English, using semantic differential judgments. The analyses looked at patterns of the semantic dimensions derived from the judgments in L2 speakers of French broken down into groups of low and high proficiency levels. The results of the French L2 groups were compared to the semantic structures of native speakers in French with two main aims: First, to test current models of bilingual lexical memory, and second, to examine possible weaknesses of a diagnostic and pain measurement tool such as the McGill Pain Questionnaire (MPQ) when used in a L2. Results indicate support for the separate conceptual features of the Distributed Features Model of vocabulary acquisition as well as the developmental aspects of the Revised Hierarchical Model. Possible misunderstandings with the intensity and affective dimensions in L2 speakers indicate potential challenges for use of the MPQ. Finally, the methodology used in this research has potential as a high-level measure of fluency.

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The Language of Pain in the Bilingual Lexicon

In a multi-lingual, multi-cultural society, encounters where one person must communicate with another in a second language (L2) are not uncommon. In the case of communications between health care providers and patients, misunderstandings due to lack of proficiency in the language can be a serious barrier to effective and efficient treatment (Bélanger, 2003). When specific words related to descriptions of pain are used as diagnostic tools, as they are with the widely used McGill Pain Questionnaire (MPQ) (Melzack, 2005), accurate knowledge and shared consensus of their meaning becomes vital for all parties involved. This might be a problem when a single shared language is involved, but it is even more so when the questioner and the patient do not speak the same language. Even in a predominantly bilingual region, complete bilingual fluency is seldom the norm and often the party speaking or listening in an L2 will be at some partial level of proficiency. Thus, the questions of what types of misunderstandings could be most common in this area, what the consequences of those misunderstandings might be, and how we can avoid such misunderstandings are of importance.

While models of L2 vocabulary storage have been the subject of investigation in the past (de Groot, Dannenburg, & van Hell, 1994; Jiang, 2000; Lambert, Havelka & Crosby, 1958; Potter, So, Von Eckardt & Feldman, 1984; Segalowitz & De Almeida, 2002), researchers are still not in agreement about exactly what the underlying processes in the development of semantic understanding are in L2 acquisition. Most of the previous research has used measurements of the speed of translating words as an investigative tool (de Groot, et al., 1994; Potter, et al., 1984), rather than delving into

specifics of how concepts develop across languages. In addition, almost no theoretical research has been done in examining the way people learn domain-specific sub-sets of vocabulary such as pain descriptor words. In fact, such a domain-specific set of vocabulary, which is not usually used in general conversation, could be of particular interest due to the fact that skill in a more specialized vocabulary could be a technique to reveal the greatest separation between those who are highly fluent native speakers and those who are otherwise quite capable in a language where other measures might find no detectable difference (Laufer, 1998). On an important practical front, expanding our knowledge of how L2 speakers understand pain-words specifically could be vitally helpful in providing effective medical consultation care to minority language populations. In today's increasingly multicultural communities, language barriers to receiving quality health-care remain an issue requiring greater understanding. The importance of this issue is particularly salient in the context of modern Québec, where non-francophone residents (especially outside the cosmopolitan city of Montréal) must communicate to health-care professionals with either party having to use their (possibly) weak L2 (Bélanger, 2003). Leaving alone the importance of these particular applications, this kind of exploration could aid in our grasp of the topic of bilingual lexical storage and L2 acquisition in general as well as providing some foundation for those who seek to improve current language-training pedagogy.

Problem Statement

The question this study addresses is how people represent the meanings of pain descriptor words in their L1 and L2 and how this varies as a function of how proficient

people are in the two languages. The goal is to see whether there are systematic differences in the mental representations of these words that can potentially undermine successful communication in the L2 relative to the L1. The general approach to this question was to obtain a measure of how pain descriptors are represented in the mental lexicon, using a technique used in psycholinguistics for the study of word meaning – a semantic differential rating scale – adapted for this special category of vocabulary.

To begin investigation on this topic, this research presents a preliminary exploratory study that hopes to help build a foundation for both theoretical and applied future research. The focus is on the semantic mapping of French and English pain descriptor vocabulary. It attempts to document how this domain-specific type of vocabulary is understood by native speakers and in particular, to contrast semantic dimensional maps of native speakers with those of L2 speakers at varying levels of proficiency.

The methodology primarily utilizes responses on semantic differential judgments (Osgood, Tannenbaum & Suci, 1965). In this task, participants judged denotative and connotative associations of each word, providing more specific quantifiable conceptual information to compare between native speakers and speakers of a L2.

The study also used two separate measures of L1 and L2 proficiency: One is the language background questionnaire (LBQ) (Segalowitz, 2009), a subjective self-report questionnaire, which documents the extent of participants' immersion in a L2. The other is a computer-based word recognition task, where the reaction times and stability of responses provide a more objective measure of language proficiency in a L2.

Comparisons were made by splitting L2 speakers into low, medium and high proficiency level groups, and exploring the semantic differential profiles which resulted from the semantic differential rankings of each group, as well as that of native speakers. This allowed for a detailed comparison of how meanings of words in a L2 transform as a function of proficiency.

Review of Literature

To describe the background of the current state of knowledge in the fields relevant to this study, a brief review of the literature is in order. To begin will be a review of the previous body of work involved with the language of pain and pain communication as it relates to the health-care community. This involves describing the existing systematic methods of measuring and describing pain, and also describing in more detail the current state of the MPQ itself and attempts so far to convert it into different languages. Although the MPQ is, in practice, at present the dominant methodology used to describe pain in the health-care community, attempts so far to convert it into different languages have not been universally successful (Boureau, Luu & Doubrère, 1992). Nor has it or later methodologies been able to determine how to effectively communicate the specific nature of pain between people who speak different native languages, even though these people may be to varying degrees described as bilingual. In addition, to examine the case of L2 learners' understanding of pain words requires an overview of the academic debate over the nature of general bilingual lexical memory, and of how the specific domain of pain-related language might fit into the picture.

Background: Pain and Communication. The mammalian and thus human brain has marvelous faculties of sensation, not only for the external world of sight and sound, but also for touch and feelings emanating within the internal world of the body. Of the sensations, those which can be grouped as either pleasure or pain could be argued as being some of the most vital in the continuance of our survival as well as in the influence of our overall happiness. The ability to sense physical pain provides rapid negative reinforcement, providing warning signs that something is wrong in the body, and even providing enough information for a trained observer to be able to tell exactly what may be wrong. The problem with this, however, is that other than for the most obvious causes of pain (i.e. putting one's hand in a fire) most of the population at large are not health professionals with the training and experience to diagnose the cause and make much practical medical use of these painful sensations. Therefore, this information must be communicated, at least primarily, through language, from those experiencing the pain to those with the knowledge of how to respond. Here we have a sensation, perception and communication issue which is difficult to convey effectively even in the best of circumstances, and this difficulty is greatly magnified when either the patient or the medical professional is using a non-native language to communicate. This type of complicated scenario is not uncommon in the modern multicultural landscape of a country like Canada, where French and English are both official languages, and far from all members of the population are completely fluent in both.

The basic responses to pain such as crying out and groaning are likely universally understood and, although they lack descriptive detail, they verge on proto-language in

that they communicate to others one's internal state (Ehlich, 1985). Given that there is no external concrete object that parents can point at in the world to teach their children exactly what the different pain sensations are, we are left to infer these things ourselves through deduction and vicarious learning. Because this linguistic description of inner abstract states is not clear, the philosopher Wittgenstein specifically used describing pain as an example as to why inner truths are so difficult to communicate (Lascaratou, 2007). The abstract nature of these types of sensations further complicates cross-linguistic communication as psycholinguistic research has discovered that it is harder (and slower) to translate abstract words than concrete ones (de Groot, et al., 1994).

The English word "pain" itself likely has its etymological roots in the Latin language word "*poena*" which had a meaning of punishment or penalty. However, the English "pain" is now primarily used to denote physical pain (while also colloquially meaning something difficult to do; e.g., "finding a bug in a computer program can be such a pain."), while the French cognate "*peine*" retains the original meaning of punishment (as well as sometimes meaning sorrow). The French word "*douleur,*" which has its roots in the Latin word "*dolor,*" shares its ancient meaning by referring both to physical pain as well as emotional or mental suffering (Jackson, 2002). It is denotative and connotative differences such as these that can make exact translation equivalents difficult to find between even closely related languages like French and English. Furthermore, those differences may only be understood by those who have very high levels of fluency in both languages, let alone somebody with moderate ability in one or the other. One phenomenon which might implicate misunderstandings based on these differences would be that of 'false friends' in a L2. An example of a false friend for a

native English speaker learning French would be the French word *actuel*, which might appear to be related to the English word 'actual.' However, the French *actuel* means present, as in "the present situation," while the French word *réel* has a closer meaning to the English 'actual.'

The Role of Language in the Measurement of Pain. The definition of pain generally accepted by the medical community was proposed by the International Association for the Study of Pain (IASP) in 1979. It defines it in its strictest sense as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Lascaratou, 2007). However, more refined definitions have pointed out that focus on the physical aspect should not be the main emphasis; rather it should be on the perceptual aspect which is a private subjective experience, and that some causes of pain can be psychological, but we might describe those pains using descriptions originally associated with similar feeling physical sensations (Merskey, 1994).

In the case of the discovering the exact meaning of words used in describing pain, there are multiple practical reasons to place importance on obtaining a clear understanding. Two very important needs in health care are in measuring pain levels to help in reducing their severity as well as a tool in helping diagnosis. In the former case, the operationalization of pain descriptors within a single language has aided the evaluation of the effectiveness of analgesic drugs. In this role, a baseline pain level must be first established and a reliable measure of post-treatment reduction in perceived pain levels must be obtained. The first attempts at measurement of pain levels were simple

intensity rating scores on a single dimension and did not explore fully the differences in nuance that a language's pain words hold inherently in this regard. One of the first scientific instruments to determine levels of pain intensity was called the "dolorimeter" an instrument explored extensively in the late 1950s (Melzack, 2005). This instrument produced painful sensations by focusing either radiant heat from a small light bulb or by applied pressure, whose intensity could be controlled by a variable dial notched in units of measurement called "dols." The unit was applied to the skin of people who would be asked to compare the pain from the dolorimeter with their memories of various other previously experienced pains to estimate their intensity in dols. This methodology has clear issues in its validity, as pain from a burning light bulb is qualitatively different from other types of pains such as headaches or cramping and it was later discarded in favor of subjectively rated unidimensional intensity scales, which came in a number of guises.

One early subjective unidimensional scale was the Visual Analogue Scale (VAS) (Langley & Sheppeard, 1985) which involves a line printed on a page of paper which is usually 10cm in length and oriented vertically with verbal labels indicating extremes. Commonly used are the words "absolute" at the top and "no pain" at the bottom. The patient draws a mark on the continuous line to indicate the intensity of their current pain sensation. The benefits of such an approach as the VAS are that limited linguistic knowledge (understanding of the general vocabulary, commonly used words at the two extremes) is needed, and due to the non-discrete nature of the scale, small changes in pain are able to be detected. However, through testing the reliability of this method, the measurements have proved to be non-linear in practice and individuals' subjective bias has been seen to easily creep in (Langley & Sheppeard, 1985). Other unidimensional

intensity scales of note include Numerical Rating Scales (NRS) and Word Descriptor Scales (WDS). In a NRS, the setup is similar to a VAS except that it is usually horizontal and contains discrete marks to be circled, usually between 0 and 10 where 0 is labeled verbally with the extreme "No Pain" and 10 "Worst Possible Pain." Again, as with VAS, the NRS notably requires only knowledge of limited general usage vocabulary. The WDS on the other hand, has no numbers, but a vertically ordered list of multiple words within the language which have been reliably tested across a large population to be perceived as holding descriptive meanings which are increasing in intensity levels. The users of the scale must choose one of these words from the ordered list in response to the query: "Please choose the word that describes your pain." Commonly used in English language versions of the WDS are the ordered list of words: None, Mild, Moderate, Severe, and Very Severe. Studies in an emergency room setting with English speaking and Spanish speaking patients and respective translations of these words found that both NRS and WDS were compared as equally effective by all parties (Puntillo & Neighbor, 1997). This provides further validation that the order of the WDS words is correct while also indicating that using generic intensity descriptor vocabulary holds no special advantage over the numbers of the NRS which rely only on two general extreme descriptors, minimizing the need for more advanced linguistic ability.

In addition to these previously mentioned scales a non-verbal version with smiley (or rather degrees of frowning) faces ranging from smiling to crying was developed in an attempt to make it more effective and accessible for children, the illiterate, and for cross-linguistic usage. Given the simplistic nature of these scales in only measuring the dimension of general quantitative pain intensity, attempts have been made to better

access more dimensions of at least the impact of the pain. For example, the NRS has been expanded in the case of the Brief Pain Inventory (BPI) to ask further number-rated questions on how their pain is impacting many aspects of their quality of life and mental health (Saxena, Mendoza & Cleeland, 1999). This provides information about the more long-term aspects of the pain experience in a more holistic manner, which is of great use in improving quality of life for pain patients. However, the introduction of an increasingly verbally oriented scale introduces much more room for possible misunderstandings by a less-than-fluent L2 speaker as far as their exact denotative and connotative meanings. These pain intensity scales have been deployed for emergency room triage nurses to classify incoming patients but primarily they have been used to evaluate the effectiveness of drugs or more comprehensive pain-reduction strategies. In one example, a study assessing cancer pain in North India used verbal rating scales (a version of the BPI translated into Hindi) to determine that three-quarters of the patients in the region of the study were not adequately treated in accordance with World Health Organization standards (Saxena, et al., 1999).

Further refinements to developments in pain descriptor ratings (like the MPQ) use a variety of qualitative word descriptors categorized into classes and sub-classes and further ordered by intensity level (as in the WDS), in addition to making markings on a diagram of a human body localizing the sensations. This has allowed physicians to address a second important practical need, which is to actually be able to diagnose or at least narrow down the possible diagnoses of a patient. The MPQ was the brainchild of Ronald Melzack, who considered that specifically the concept of the dolorimeter and in

general measuring pain assuming they are all qualitatively the same and differ in intensity alone, was the wrong approach (Melzack, 2005).

The MPQ was first published in its modern form in the journal *Pain* in 1975 (Melzack). He reasoned, using physiological theory to base his argument, that if there were a single pathway for pain from skin to the brain, then the feeling of a kick to the shins would be the same for all sensations ranging from a tiny burn, to a headache, and also a heart attack - differing only in intensity. Given that this was not the case, and also from his observations of the impact of psychological, top-down, influences on the perception of pain, he deduced that it was possible that there are indeed multiple pathways of pain from the source to the brain, as well as pain inhibition travelling in the opposite direction. This led to formulating a grand theory of pain perception, called "gate theory", which allowed for multiple physical pathways, providing a basis for classes of pain and laying the foundation for the possibility of tools like the MPQ to be developed for use as a systematic aid in diagnosis (Dubuisson & Melzack, 1976; Lowe, Walker & MacCallum, 1991).

Gate theory (Melzack & Wall, 1965) is based not only on physiological theory, but on actual neurological observations that there are two distinct pathways for pain transmission in the central nervous system. The lateral system has myelinated nerves passing through the side of the brain stem which is activated by acute pain such as a cut. Longer lasting pains, however, pass through the medial system, with unmyelinated nerves which go through the core of the brain stem, producing more dull, sometimes rhythmic pain sensations. Key to the gate theory beyond these bottom-up sensory pathways, is the information that psychological factors can modulate the pain experience in a top-down

manner, which acts through a third set of nerve fibers which travel down from the brainstem feeding back on the other two systems and can inhibit their firing, thus effectively "closing the gate" and reducing the pain (Kandel, Schwartz & Jessell, 2000). In addition to fruitfully opened up the exploration of non-drug-based techniques in reducing perceived pain, gate theory is very significant in the current context as it has provided a physiological foundation for the systematic classification of types of pain (that could theoretically be matched by pain descriptor words pre-existing in a language's vocabulary).

The Classification of Pain Vocabulary. Although learning words to communicate about and describe experienced pain sensations is a subjective and abstract affair, there is, despite this, some considerable consistency in how people use those words, at least within native-speakers of a language. One possible explanation for this consistency is that some words which people use to describe pain are analogies to previous concrete direct experiences, such as when one is cut by a knife or burnt from a fire or stove, thus the words cutting pain and burning pain can be associated with similar feelings to the former concrete direct experiences. Other words come up commonly in pain descriptions because they describe aspects of the painful sensation that can be understood generally based on time and space and applied to the subjective pain sensations, words such as "throbbing" or "pulsing" to describe rhythmic pains. In addition, shooting, flickering and quivering could be used to describe rapidly changing intermittent pain that may be perceived as moving in its location within the body. Given that the same types of words are used in describing pain by so many people within native

speakers of a same language seems to imply that there is something common in the human nervous system in how we experience this (Jackson, 2002).

After noticing these similarities in vocabulary used in the freely elicited descriptions of pain of chronic pain patients and those with phantom limb pain, Melzack began collecting as many English pain words as he could in the 1960s, coming up with a grand total of approximately 200. Being a proponent that the experience of pain was a complex multidimensional phenomenon, he found that most of the pain descriptors could be distilled into three main groups which consisted of what he labeled as the sensory, the evaluative and the affective. Conducting research to validate these categories, he had patient and doctor volunteers each judge whether they understood the descriptors and to classify the words based on their perceived similarity or difference and then submitted the collated results to the statistical technique of multiple group discriminant analysis. The analysis found that 16 sub-groups (and four miscellaneous ones) were differentiated from each other where only a core 78 descriptor words remained. In addition to qualitative classification, these words were also further individually rated for quantitatively ordered intensity by the volunteers on a 5-point VRS ranging from 1 as "mild" to 5 as "excruciating" (Melzack & Torgerson, 1971). The results were compiled together to form a derivative questionnaire including the words, rank ordered by their pain intensity levels, and categorized by the classes they were put into. The verbal sections of the questionnaire were accompanied by a non-verbal diagram of the human body for patients to mark the location(s) and direction (if any) of the movement of the pain.

Further studies on the effectiveness of the instrument tested its usability in diagnosis. In one particular study, 95 native-English-speaking patients with eight already known pain syndromes (phantom limb, cancer, degenerative disc disease, toothache, post-herpetic neuralgia, menstrual pain, labour and arthritis) were given the MPQ and their answers were subjected to a multiple group discriminant analysis. Each syndrome was found to occupy a distinct region in multidimensional space where the constellations of words were statistically different from the other constellations but not within each constellation (Dubuisson & Melzack, 1976). These results provided further validity for the systematic classification of English pain descriptor words in the manner of the MPQ (see Figure 1). In addition, they provided evidence that this questionnaire proves to be invaluable practically for improving health-care. Just by analyzing the constellations of words of a particular individual's descriptions, a correct diagnosis could be made for 77% of the individual cases (Dubuisson & Melzack, 1976). Further similar studies have confirmed this practical ability of the questionnaire including one in particular where the MPQ could differentiate between labour pain and post-operative pain in 192 women (Lowe, et al., 1991). The MPQ is also effective as a multi-dimensional pain intensity scale, and has since its inception become the most recognized standard tool worldwide to use in both applied clinical as well as experimental settings (Lowe, et al., 1991).

The McGill Pain Questionnaire across Languages. The across-the-board popularity, reliability, and effectiveness of the MPQ as a multi-purpose tool has led to a continued pressing need to have versions of it in more languages than just English. This conversion task has proved to be a complex and complicated one as exact translation

equivalents are so rare between languages for qualitative pain descriptor words such as the ones used in the MPQ. The scarcity of exact translation equivalents is but one problem, as Halliday (1998) noted in describing the grammar of pain, where different languages often express pain as a noun, adjective and/or a process in quite differing ways. In addition to issues in exactly translating denotative meaning, connotative meaning can vary subtly and not-so-subtly between languages. One would expect that this type of nuanced meaning would be that which is least understood by a non-native speaker, but could be absolutely vital in affecting the effectiveness of the MPQ as a finely-tuned diagnostic instrument.

The original English version of the MPQ has now been converted into a great number of different languages and dialects, acknowledging that regional differences in denotative and connotative meaning within a single language could vary in a nuanced but significant manner. The MPQ's current translation attempts that have been completed include French (Continental and Québécois), Finnish, Norwegian, Brazilian Portuguese, Spanish (Continental and regional South American), Cantonese, Russian, Tagalog, Hindi, amongst others, covering languages used in 42 different countries (MAPI Research Institute, 2006). However, the method of conversion between these different language versions is far from consistent, ranging from simple direct dictionary translations of the words to attempts at recreating the MPQ-version from scratch using the same or a similar methodology to that used originally by Melzack and Torgerson (1971). The latter method of recreating the MPQ in different languages has produced differing numbers of total words used as well as differences in sub-classes and number of words in each class and sub-class. Another important inconsistency between the conversions has been that

most of them have not been subjected to validation or reliability studies after they have been created, often relying only on the validation and reliability of the original English version (Boureau et al., 1992).

Attempts at converting the original English McGill pain questionnaire into French have included three versions made in Québec, Canada, which unfortunately have not been subjected to validation studies with a Francophone Québécois population as had been done with a local Anglophone population while designing the original English version. A study to determine the effectiveness and validity of the three Québécois versions versus one reconstructed from scratch in France (the Questionnaire Douleur Saint-Antoine) found that the continental French version was valid in France, but the Québécois ones were not (Boureau et al., 1992). This result underscores the significance of differences in usage, denotation and connotation between two regional variations of the French language that are not even yet considered officially distinct dialects.

An important aspect of the use of the MPQ, or any verbal pain rating scale in different language populations is that although considerable (albeit uncoordinated) research has been done on making different language versions, there is no understanding of how varying degrees of proficiency in a L2 would affect one's understanding of the meaning of pain words. This kind of situation arises often in today's multicultural countries, as well as being exemplified in Québec, where many Anglophones living in areas outside of the metropolitan city of Montreal find it difficult to obtain satisfactory healthcare in the English language and often must deal with nurses and doctors using their L2, or they must use their rudimentary French vocabulary if they have it (Bélanger, 2003). To examine the case of L2 learners' understanding of pain words requires an

overview of the current state of the academic debate over the nature of general bilingual lexical memory, and how the specific domain of pain-related language might fit into the picture. What is especially relevant to the questions that this research hopes to address is the question of how the knowledge of vocabulary in a L2 changes as a function of proficiency.

Bilingual Lexical Memory. L2s are learned necessarily alongside the lexical and syntactic base of the learners' native language. A question that this raises is how the meanings of words in the native language affect words acquired in a L2. This question is important because not all direct translations of a word from one language map exactly onto the exact denotative and connotative meanings of a word in another. They might require a full sentence to describe the concept in the other language. If L2 learners use their native vocabulary as a peg board to attach on new, seemingly equivalent meanings for words, they could be carrying over some of the common overlap in meaning in addition to bringing extra baggage in the form of meanings and connotations which should not be present in the new vocabulary. In addition, they may also miss new connotations that may be present in words from the L2 which are not connected with the closest translation equivalent in their first language.

If this kind of conceptual borrowing is taking place, it might be assumed that it occurs only in those beginners who have only a cursory understanding of the new language. It is then likely that as they advance in knowledge of the new language that they will develop a richer understanding of the subtle differences in meaning and usage between the two words. If this is the case, then it has important implications on a number

of levels. Firstly, at a theoretical level it helps us better understand how we store both lexical form (orthography) and concepts in native languages as well as second and third languages: Are the lexical forms somehow stored separately but linked to the concepts? Do words in a new language refer to the closest equivalent words in the native language which then act as mediators of the conceptual meaning? In what fashion and to what degree does greater experience with a L2 improve upon this mediation? At a practical level these questions can help provide more targeted techniques in helping language learners acquire correct and more nuanced meanings of new vocabulary. This could also help to explain a lot of errors and misunderstandings that a L2 learner experiences. Areas where these kinds of errors could be critical might be best exemplified by the medical consultation where linguistic misunderstandings could be the difference between a correct diagnosis by a nurse or doctor, aided by the descriptions of the patient, or a misdiagnosis resulting in at best no help, and at worst harming the situation further instead of helping, leading to progression or aggravation of the illness or condition and perhaps even otherwise avoidable death of the patient.

Previous researchers have addressed this issue of how we structure lexical knowledge in a L2 by attempting to produce testable hypothetical models of the stages of linguistic development. The earliest model published in the field of modern psycholinguistics is the view that each language has its own discrete conceptual underpinnings (Lambert, et al., 1958). Later evidence, however, provided support to an alternative idea that there is but a single shared conceptual level, and focus then shifted to examining whether this conceptual level was directly connected to the vocabularies of each language, or if second and third language words had to pass through the native

language's closest equivalent to access its meaning (Potter, et al., 1984). Further exploration of this model experimentally provided further refinements which incorporated qualitatively different structural stages for varying levels of proficiency. The most recent debates have focused on exactly what underlying processes could be producing the phenomena found in the experimental results.

Before going into more detail about the current state of those debates, it would be appropriate first to explain the basis of understanding that is shared by these theories. If we were to give a term to the thinking process as a language in its own right, it could, and has been called *mentalese* (Carroll, 2004). It is theorized that we have abstract concepts in our minds representing objects, feelings, and actions (indeed virtually everything) in the inner and surrounding world (Smith & Medin, 1981). These abstract concepts, or meanings, have been seen as a discrete layer in our minds and brains and are linked with what are known as the corresponding lexemes in our native language. These lexemes contain both the auditory and written forms of the word as well as any syntactic and social rules governing their use (Carroll, 2004). With a native language, this link between concept and its respective lexeme is very strong and activation of one by the other is automatic, rapid, efficient and unstoppable (Segalowitz & Hulstijn, 2005). The extent of this activation has been well documented by the use of experiments involving both the Stroop effect and with semantic priming as methods of investigation (McNamara, 2004).

Coordinate and Concept Mediation Models. One of the earliest approaches for explaining the structure of lexicons for multilingual individuals was the distinct meaning

hypothesis (Lambert, et al., 1958), which has been also referred to as the coordinate model (see Figure 2). This hypothesis consisted of the basic idea that there are separate and distinct lexical stores for each language where the new vocabulary in a L2 is acquired simultaneously with its own discrete conceptual semantic meaning. Interlingual lexical associations then link the vocabulary between multiple languages. Because it postulates separate abstract conceptual representations for each language known, this model would not expect to find any carryover from connotative meaning or social use rules from the L1 over to the respective L2 vocabulary.

However, as experimental evidence began to be collected, the arguments discounting the idea of multiple separate conceptual stores was strengthened. The consensus amongst researchers was that the distinct meaning hypothesis was overly simplistic. The debate then started to focus instead around models of a hierarchical nature in which a common conceptual and semantic meaning is shared by the separate orthographic and auditory lexical forms of words from each language (Jackendoff, 1997). Potter et al. (1984) contrasted a mediation model, in which the lexical forms of each word in both L1 and L2 were both directly linked to a common conceptual representation, with a word association model where acquired L2 vocabulary is linked indirectly to the conceptual meaning via the equivalent L1 lexeme (see Figure 3).

This experiment by Potter and colleagues used a common assumption that mental pictures of objects are accessed separately from their respective conceptual representation. Mental pictures are thus assumed to be linked to their respective conceptual representation which is in turn linked to the L1 lexeme. The methodology of their experiment involved two conditions. In one, participants saw a basic line-drawn

picture that they had to name in their L2. In the other, participants simply saw a printed word in their L1 or L2 that they had to translate. It was hypothesized that if the word association model of concept-lexeme linkages was the most accurate, then picture naming in the L2 would have to go first through the conceptual representation and then the L1 lexeme before being able to access the L2 word, passing through two stages to reach it. Therefore, picture naming in the L2 should be slower than simple translation of a L1 word into the L2 which would require only a single step. On the other hand, if the concept mediation model was more accurate, then the picture-naming task in the L2 should take an equal amount of time as the L1 to L2 translation, because both would involve a situation where the picture activates the concept which would in turn activate its respective lexeme directly. Their results found the latter case to be true, that there was no difference in time between naming the picture in the L2 and translating the L1 word into the L2. Their study had subjects who were fluent bilinguals as well as less-proficient bilinguals and they concluded that the concept mediation model was likely the more accurate model (Potter et al., 1984).

However, challenges to Potter's conclusion came from multiple directions. For example, Kroll and Stewart (1994) found differences in L1 and L2 behavior in word translation where translation within a semantic category showed category interference when translating from L2 to L1 but not vice-versa. They concluded that this was due to L2 words being associated directly with L1 rather than linked via concept mediation. Further experiments using cross-language priming, where words in one language were able to facilitate the speed of lexical decision tasks (judge if a target is a word or nonword) in the other language, also found a similar asymmetry where L1 primes caused

much stronger L2 activation than the reverse direction (Keatly, Spinks & De Gelder, 1994). The lack of difference in beginning versus advanced bilinguals in Potter's 1984 study, however, was determined to be due to an overly liberal definition of beginner. Kroll and Stewart found differences between beginners and experts when a stricter criterion was used (as cited in Heredia, 1997). They found that beginners who had been speaking the L2 for less than 2.5 years performed in concordance with the word association model, while the performance of advanced speakers seemed to fit better with the concept mediation model.

These results led to the proposal of a developmental hypothesis by Kroll and Stewart (1994) which contained both models, which they called the revised hierarchical model (RHM). This RHM postulated that language learners begin by mapping new vocabulary onto already existent translation equivalents, which is closest to the word association model. Then as they become more experienced with the language, connections develop directly from the L2 vocabulary to the concepts (see Figure 3). This model also takes into account the asymmetrical connection between L1 and L2 by describing a weaker link from L1 to L2 than vice versa, a pattern that could not have been described by either of the previous models alone. The RHM, however, has trouble explaining why there are strong priming effects for lexical decision tasks within the L2, which should, according to the model, have weak connections (Finkbeiner, 2002).

Not long after, the researcher Nan Jiang (2000) outlined a similar, but in this case, triple-staged model of vocabulary acquisition in a L2 which attempted to address differences in translation equivalents' meanings. Jiang proposed that in the first stage, when the lexical entry is first introduced, the form of the L2 is linked to the translation

equivalent, relying on the L1 entry's semantic, syntactic and morphological specifications. In the second stage the L1 lemma information is copied over to the L2 entry due to continued co-activation, and the L2 now has a tentative direct link to the concept. In the third stage, after continued contextual input modifies and refines the L2 entry's semantic, morphological and syntactic information, the conceptual link strengthens in a way that reflects the particularities of the L2 meaning.

The concept-mediation models will provide the hypothetical backbone for the expected results for the proposed experiment. The concept-mediation models would predict that the pattern of the semantic "maps" (the semantic differential profiles produced by the semantic differential judgments) for pain-descriptor words of low-proficiency L2 speakers would be more similar to that of the patterns in their L1 than for high-proficiency L2 speakers.

Feature Based Models. Not all researchers have embraced the common meaning models like the RHM however. A notable alternative explanation for the asymmetrical priming effect came from Annette de Groot (1992) who proposed the distributed feature model (DFM). This model claims that this effect comes from the differences in overlap between features that vary depending on the type of words (see Figure 4). For example, a chair and table (concrete objects) both share the conceptual features of 'furniture' and 'have four legs' in almost any language. Experiments on the DFM have primarily involved the difference in distributed features between concrete words (e.g., house), which refer to perceivable objects, and abstract words (e.g., terrifying), which one can describe, but cannot be directly pointed at and named. This aspect of the DFM makes it

particularly salient to the study of subjective sensations such as pain descriptor words. The DFM notes that concrete words have many more features in common that overlap across languages to their translation equivalents than do abstract words. Experiments where other variables are held constant (word frequency and word length) have shown that bilingual participants have quicker response times to words that are of the concrete type than those that are abstract in a variety of lexical processing tasks (de Groot et al., 1994).

Ultimately, how we learn and store concepts and the lexemes in a first and L2, remains a matter of discussion. It is also quite possible that the manner in which we learn additional languages may also influence the progression of the lexical organization. Given that classroom or textbook learning techniques often utilize dictionary style methods where L2 vocabulary is learnt through translation equivalent lists pairing native language (L1) words with their respective L2 words, it would not be surprising to find that often these words are taken to be exact equivalents. In many cases involving concrete words representing nouns (i.e. words referring to things one can clearly point to in the external environment) this exact equivalence is most probably an accurate interpretation. However, as bilinguals will anecdotally remark, with non-concrete words (i.e. emotions, adjectives, sensations, etc…) there are subtle and not so subtle differences in their connotative if not denotative meanings and in the contexts of their use. With this in mind, Tokowicz, Michael and Kroll (2004) conducted a study examining the amount of study-abroad experience that participants had, while controlling for working memory capacity, and specifically looking for what types of errors were made in translations. What they found was that increased study-abroad experience increased the number of

mistaken meaning errors in proportion to simple non-response errors. They concluded that study-abroad immersive experience encourages learners to use more approximate translations that are not perfect in order to attempt to communicate with less than fluent knowledge. It is, however, possible that these results are due to the study-abroad experienced group being bolder in the use of the language rather than actually having acquired a different lexical organizational structure. Given results like this, a study examining L2 understanding of a domain-specific vocabulary such as pain descriptor words should attempt to take into account qualitative differences in fluency as well as quantitative attempts at measuring fluency.

While there may not be a consensus on the exact processes underlying the acquisition of new vocabulary in a L2, there are enough similarities amongst the models to provide guidelines for structuring a study of the semantic structure of French and English pain words. The results of such an exploratory study can, by providing supporting or opposing evidence to these models, also hopefully provide some contribution to this greater theoretical debate.

Statement of Objectives

Given that little is known about the nature of what misunderstandings might occur between health-care providers and patients who do not share the same L1, and given the importance of accuracy on this topic when dealing with descriptions of pain, a systematic study is overdue. The focus here is on the semantic mapping of French and English pain descriptor vocabulary. In particular, a sub-set of words (see Table 1) taken from the

respective language versions of the MPQ is examined in detail. One main set of measures (semantic differential ratings) assesses the meaning of the set of words, and two sets of measures assesses language proficiency (a subjective and objective measure). The analysis itself involves examining the semantic understanding of the words in the L2 as a function of proficiency, while comparing those semantic understandings to that of native speakers.

Semantic mapping is accomplished by collecting the results of bilingual participants' judgments on semantic differential scales. The semantic differential scales are designed to cover a number of different conceptual dimensions which sensations of pain could be described by (i.e., spatial, temporal, temperature). A baseline for semantic meanings is established by mapping out the judgments of native speakers in their L1. This native speaker (in French only) baseline is then compared to the patterns of responses given by participants in their L2 at low and high levels of proficiency (English L1 speakers who speak French as a L2). The semantic-differential data provides more specific details on what features each word shares.

Given the evidence supporting the current theoretical models of bilingual lexical memory, including the RHM (Kroll & Stewart, 1994), DFM (de Groot et al., 1994) and Jiang's model (2000), one would expect a certain pattern of results where the semantic maps derived from the semantic differential judgments for low proficiency speakers in their L2 would be similar to that of their L1 translation equivalents, due to the hypothesized lexical mediation.

In addition, given the importance of the MPQ as a medical diagnostic tool, and given that oftentimes either the health-care practitioner or patient will need to be

speaking or listening in their L2, understanding what exactly the deficiencies in understanding are at various levels of proficiency could be a first step in helping to remedy those deficiencies by focused language training.

To summarize, the following hypotheses are explored in this research on French-English bilinguals who are native speakers of one language and L2 in the other:

1. That the semantic differential profiles for words in the L2 of low proficiency speakers would more closely resemble that of their L1 translation equivalent;
2. That with increasing proficiency in a L2, the semantic differential profiles will more closely resemble that of native speakers.

The Experiment

This study aims to shed light on how native-speakers of French or English learn the pain-descriptor vocabulary of the other language at varying degrees of proficiency. The method of investigating this question here is through the use of subjective and objective measures of language proficiency and judgments on the meanings of pain-descriptor words in both English and French. These judgments are analysed for differences across proficiency levels by means of MANOVA. The comparison of the semantic maps across differing levels of proficiency should provide evidence for or against the prevailing models of bilingual lexical memory (de Groot, et al., 1994; Jiang, 2000). In addition, from the dimensional ratings in the resulting semantic maps, the dimensions with the largest disparities between beginning and native speakers can be discovered, thus identifying potential areas of weakness for the implementation of a verbal pain scale such as the MPQ with populations communicating in a L2.

The experiment consists of two main parts. The first part consists of measures of proficiency, and the second consists of measures of the perceived meaning of the target vocabulary. There are three measures of proficiency. The first is a test of word recognition and basic comprehension; the second are subjective self-reports of language proficiency, experience and confidence. The third is an objective task aimed at establishing general fluency through measuring automaticity and efficiency in word recognition.

The second main part of the study aims to elicit the participants' understanding of the semantic meaning of selected pain descriptors in both languages. This will be done by semantic differential judgments on the denotations and connotations that these words are associated with.

Beyond the dimensions covered by the MPQ classifications themselves, one might expect that there are connotations with these words that might further distinguish the fine-grained knowledge of a cultural and linguistic native, against someone who is initially just learning the surface meanings that could be established by use of the semantic differential method (Osgood, et al., 1965). These connotations might cover areas like social and pragmatic connotations such as whether a word is considered to be polite or rude, or spoken mostly by urban or rural and educated or uneducated persons. There may also be words that are expected to be heard or spoken more by younger or older people or words that might be considered to be more commonly used by female or male speakers. Finally, some descriptor words might connote the desire for an exaggerated dramatic effect, while others might be known to be used frequently by those who wish to understate their condition.

The ultimate aim is to compare the pooled semantic understanding of native speakers (which hypothetically should be relatively homogenous) with those of L2 speakers at varying degrees of proficiency and with different language backgrounds. Hopefully this will produce fruitful momentum to the debates on bilingual lexical storage in general, as well as provide a map of areas of weakness in the specific domain of pain descriptor vocabulary which could be of use in attempting to reduce the barriers to effective treatment for patients and health-care practitioners who have to work in a L2. The expected hypotheses are that: 1) Low proficiency speakers of a L2 should show little to no difference in the semantic maps of their L1 and their L2 translation equivalents; and, 2) These L1 and L2 semantic maps should become more distinct as proficiency in the L2 increases, so that they resemble more and more that of native speakers.

Method

Participants

Thirty-two participants took part in all, 10 of whom were native speakers (L1) of French who speak English as an L2 and 22 of whom were native speakers of English who speak French as a L2. The participants were recruited from the university undergraduate population and from the local region of greater Montreal and compensated by either course research participation credits or money (14$) for their time.

Materials

The materials were a combination of a paper-based questionnaire, the LBQ, and a variety of computer-based tasks run on Apple Macintosh computers running OSX and with the experimental programs written and run in MATLAB and PsyScope (Cohen, MacWhinney, Flatt, & Provost, 1993) programming environments.

Language Background Questionnaire (LBQ). The first focus was determining the level of proficiency of the participants in their L1 and primarily their L2. This was accomplished using both a subjective and objective measure. The subjective measure was the use of the language background questionnaire (LBQ) as used by Taube-Schiff and Segalowitz (2005), which allows the participant to self-report the amount of experience and types of exposure they have had in using their L2 using five-point Likert-type scales as well as self-report their fluency, dominance and confidence in the language (see Appendix). The purpose of this questionnaire is both to determine their self-rated ability as well as confirmation that their dominant language is either French or English.

An important facet of the LBQ is that it contains questions asking indirectly about the degree of cultural immersion and range of experiences in the L2. Since differences have been found in the abilities and language behavior of individuals based on the main method of their language instruction, whether it be through immersion, or classroom and textbook learning (Tokowicz, et al., 2004), one might hypothesize that such differences in background could manifest themselves as significant differences in connotative understanding of L2 vocabulary. To further focus on the language experience aspects of the questionnaire, there is an addendum to ask about vicarious and direct experience with health-care and pain related communication in both the L1 and L2 (see Figure 5).

Pain-Descriptor Word Stimulus Set. The stimulus set of pain descriptor words includes 12 of the most basic descriptor words used in the MPQ (see Table 1), broadly spread across all the sub-classes limited to the sensory category of the questionnaire (see Figure 1). The words are matched by the closest translation equivalents used in the corresponding French (Québécois) version of the MPQ for the French stimulus set. All the pain descriptor words used as the stimulus set have been selected based not only on an even spread across the sensory categories, but also selected based on the most commonly known and used words (as determined by a previous pilot study involving both native English and French speakers) to increase the likelihood that they will be recognized and understood by a non-native speaker.

General Word Recognition Proficiency. In addition to the self-report questionnaire, an objective measure of word recognition proficiency, focussing on the automaticity and efficiency of general lexical processing that is intimately linked with fluency has been used to obtain an additional measure of L2 proficiency. This is an adapted version of the Person/Object word recognition task reported in Segalowitz and Frenkiel-Fishman (2005). This measure is a speeded, button-press reaction time task in which participants categorize a stimulus word presented on the computer monitor as referring to a person or an object (see Figure 7). This task yielded a reaction time (RT) measure of speed of processing and a coefficient of variation (CV) of intra individual variability of RT, a measure of the efficiency of processing (Segalowitz & Segalowitz, 1993).

Pain Word Recognition Task. To confirm a basic comprehension of the pain descriptor words that make up the main stimuli in this study (see Table 1), the

participants performed a recognition task which was conducted in both languages where they were presented with a triad of three pain descriptor sentences, where only one is valid and common usage in the language while the other two are believable, but incorrect, distracters. The key word to be recognized as the most valid pain-word descriptor was highlighted in bold. For example, in English, a correct choice might be "a **burning** sensation" and an example of an incorrect choice might be "a **slipping** sensation."

Semantic Differential Task. This section included the presentation of one word at a time being shown at the top center of the screen and with a seven-point Likert-style scale below it with polar opposite words (see Table 2) on either end of the scale (see Figure 9). The number "4," in the middle of the scale can be chosen by the participant as a neutral or undecided answer. The polar words measure both denotative and connotative dimensions of the stimuli descriptor word. One dimension which will be necessary to look at is the perceived intensity of the word, as was done to rank the words in the MPQ using the Present Pain Intensity (PPI), using a seven-point scale, with the word "mild" written on the left side (marked "1") and "excruciating" on the right (marked "7"), with the closest possible translation equivalents used in the French language for French L1 participants. The other dimensions look at analogues of the sub-classes of the MPQ (see Figure 1) including Temporality (Constant vs. Intermittent), Spatial (Stable vs. Moving, Localized vs. Diffuse), Thermal (Cold vs. Hot), and other qualities (Dull vs. Bright, Soft vs. Hard). In addition to the sensory sub-class of the MPQ (see Table 2) from which the descriptor words have been taken, some affective dimensions of these words are investigated (Calm vs. Anxious).

Procedure

The participants were tested in a single session lasting approximately one hour and a half. At the time of recruitment, participants were screened to ensure they met the eligibility criteria, namely that they speak French or English as a native speaker with the other language as a L2. At the time of testing, they were given consent forms to complete and then were provided with the LBQ to complete by hand.

After completing the LBQ, the participants performed the various tasks in the following order. For every task, the English and French section were done separately, and the order of presentation of each language was counterbalanced across participants.

Pain-Word Recognition Task. The Pain-Word Recognition Task was done in both languages, presenting the stimuli words in context sentences along with two non-pain related distracter words within similar contexts. The participants had to indicate by a key press which of the three sentences they believed contains the legitimate pain-descriptor word.

General Word Recognition Task. After these initial tasks, the participants continued on to the word recognition task. The word recognition task was (as were all further tasks) counterbalanced for order effects, evenly distributing whether participants start in their L2 or L1. After the presentation of an instruction screen, and before the full task, a short number of trials were conducted at the beginning that were practice trials, the participants were informed of this. Within each language, the participant had to respond with either a left-hand response on one computer key or right-hand response on another key based on the categorization of the presented word (see Figure 7). Reaction

times were recorded of the participants' response times. There was a time-out period of 3s if the participant did not respond in time and the response was then marked as a timeout. After completing the first block of language trials, the participant began the second block of trials in the other language. The practice trials were not included in the final analysis.

Semantic Differential Task. Finally, at the same computer terminal, the participants proceeded to engage in the semantic differential task. In this task, the participants were presented with a pain descriptor word with a sequentially presented series of polar opposites. They had to respond by pressing a number between "1" and "7" on the computer keyboard based on their judgment (see Figure 9). First they were provided a screen of instructions, and then they proceeded to the semantic differential task itself, where again, the first language engaged in was counterbalanced and completed before proceeding to the other language. In this task, each single word from the pain descriptor stimuli (see Table 1) was presented on-screen with two polar opposite words (taken from Table 2), where the number "1" will represent one extreme opposite position and the number "7" the other polar opposite position and numbers in between indicating some point in between. The participants' responses were recorded by the computer.

After completing all the tasks, the participants were given a debriefing form, explaining in more detail the nature of the experiment, and compensated for their time by either a receipt indicating their research participation or by 14$ cash.

Results

All of the analyses were done using SPSS 16 on an Apple computer running OSX.

Grouping by language and proficiency

The classification of participant membership into native French and native English groups was accomplished primarily by self-report. Participants' self-reported L1 was supported via examination of their responses on the LBQ to see if their self-reported L1 was their dominant language by comparing their French and English subjective proficiency ratings. By this method, the French native speakers were then isolated (n = 10) from the English native speakers (n = 22).

To prepare the measures of proficiency of the native English/French L2 participants for splitting into low and high-proficiency groupings, the French native speakers were first removed, leaving 22 participants. The remaining native English participants' responses on French L2 subjective proficiency queries from the LBQ task (ranked on five-point scales for speaking, reading, writing and listening abilities) were summed for a total subjective French L2 proficiency score. In addition, responses on the LBQ on estimated time spent speaking, reading and listening to French as an L2 were aggregated to produce a measure of total estimated time engaged in the French language. Finally, the responses to the addendum questions to the LBQ regarding experience communicating about health-care issues in French were summed to produce a French medical communication experience measure.

For the objective measure, results of the Person/Object task were analysed to produce a mean RT score and mean CV score for both the L1 (in this case English) and

L2 (in this case French). Then each of these scores was submitted to a regression analysis with each corresponding L2 score residualized against the L1 score to remove the impact of individual differences in overall ability from the resulting scores, thus producing an isolated and comparable L2 measure. As a result, a residualized mean L2 RT and a mean L2 CV score were produced for each native English/L2 French participant. This score reflected L2 performance not associated with, or predicted by, L1 performance.

An analysis of bivariate correlations was performed for the native English speakers (n = 22) on the aggregated measures from the subjective scores recorded on the participants' LBQ and the residualized results from their Person/Object task. The results showed parallel relationships between the subjective and objective measures of L2 proficiency, supporting the validity of these measures (see Table 3). The relationship of primary interest was the aggregated subjective French rating, which correlated significantly with the French L2 residualized mean RT (r = .49, p = .021). The correlation between the French L2 residualized mean RT as a measure of speed also correlated with the residualized CV as a measure of efficiency for the same responses (r = .60, p = .003), which indicates that as participants got faster in responding, they also became more stable in the time they responded, indicating increased efficiency or cognitive fluency in the L2 (Segalowitz, 2010). The addendum to the LBQ measuring self-reported experience communicating about health-care in French was also found to be correlated significantly with the total time estimated communicating in French (r = .45, p = .034) with subjective French rating (r = .69, p < .001) and the French L2 residualized mean RT (r = .42, p = .05).

The English native-speaking participants (n = 22) were then grouped into two clusters of French L2 proficiency (low and high) through the results of a K-means cluster analysis (set to a maximum of 100 iterations) programmed to produce two different groups. The included variables used to classify the groups (chosen as the most representative measures of L2 French proficiency) were their subjective L2 French rating, French medical experience rating (both aggregates from the LBQ), residualized Person/Object Task mean RT, and residualized CV. The results of the cluster analysis (see Table 4) produced 14 participants in the high proficiency group (subjective French rating M = 15.64, SD = 2.4; subjective French medical experience M = 8.57, SD = 3.7; L2 residualized mean RT M = -73.61, SD = 50.9; residualized CV M = -.028, SD = .04), and eight in the low proficiency group (subjective French rating M = 12.75, SD = 1.6; subjective French medical experience M = 5.25, SD = 2.6; L2 residualized mean RT M = 128.82, SD = 65.4; residualized CV M = .05, SD = .08). Each of these group mean measures, were significantly different between low and high proficiency groups, indicating that this clustering result provided a clear split between groups (subjective French rating $F(1,20) = 8.99$, $p = .007$; French medical experience $F(1,20) = 4.86$, $p = .039$; L2 residualized mean RT $F(1,20) = 8.94$, $p = .007$; and residualized CV $F(1,20) = 65.42$, $p < .001$).

French L1 group characteristics. For the native French L1 participants, descriptive statistics were compiled for comparison purposes. The native French L1 group had very high subjective French proficiency ratings (M = 19.1, SD = 1.5), from an aggregate of four 5-point Likert-style questions (with a maximum rating of 20) as well as very high subjective English proficiency ratings (M = 18.2, SD = 1.5), indicating that

despite their primary language being French, they were very balanced bilinguals. They also reported having plenty of experience in communicating about health-care in both French (M = 11.2, SD = 2.7) and English (M = 9.5, SD = 2.2).

Word recognition by group

Examination of the results of the pain-word recognition task, with unrecognized or misunderstood words aggregated by group (L1 French, L2 French High proficiency, and L2 French Low proficiency) revealed that the French pain-word *martèlement* was the least recognized by all groups. Since this word was the only word which even the native French speaking Canadian participants did not recognize at a rate higher than 10% (for *martèlement* the non-recognition rate was 60% for French L1 participants), it was removed from further analysis along with its English close translation-equivalent *pounding* leaving 11 stimulus pairs from the original 12.

Examining matching semantic dimensions in the L2

To examine which semantic dimensions were best and least matched with native French speakers by beginner L2 speakers, the responses on the semantic-differential task were examined for each French pain-word and split by proficiency levels (L1 French, L2 French high proficiency, L2 French low proficiency). The mean judgments on each semantic-differential dimension by the native French L1 participants were seen as the definitive ratings, providing a reference point to which were compared the mean ratings of L2 French participants at low and high levels of proficiency. The analysis to determine whether there were differences in the mean judgments for each semantic-differential dimension by level of proficiency was done by conducting a MANOVA on each French language word separately. It was expected that there would be more

significant differences in ratings on more semantic differential dimensions between the low proficiency L2 French group and the native French group than between the high proficiency L2 French group and the native French group. Also of interest was which dimensions were least matching (i.e., discrepant from the native French speakers) according to beginner French speakers, and which were the most matching.

The first step was to reduce the set of polar-opposite pairs for rating the pain descriptors to remove any pairs that appeared to be measuring the same semantic differential dimension. This was accomplished by means of a factor analysis using the Principal Component Analysis method with varimax rotation. This was performed on the responses of participants rating words in their L1 only. For each component/factor identified, the word-pair with the highest eigenvalue was determined to be the representative of that factor, and any other word pair with a high eigenvalue (greater than 0.8) within the same factor was deemed to likely be measuring a similar dimension, and was seen as redundant and omitted from further analyses. Additionally, upon examination of responses item by item, it became apparent that two other word pairs might have been ambiguously interpreted by participants and these were then also removed for clarity and consistency in responses. In the end, out of 13 original polar opposite word pairs used in the semantic-differential task, only eight word pairs remained after the reduction (see Table 5). These were seen as measures of eight distinct semantic dimensions (with each word pair seen as representing a specific dimension, i.e. strong-weak representing the dimension of intensity) with each containing nuanced shades of meaning out of a multitude of potential dimensions.

For the analyses that follow, each French pain-word is dealt with separately (for graphical display of these results, see Figures 8-18). Differences in the ratings for each semantic-differential dimension were compared across all three levels of proficiency by pair-wise comparison. For the purposes of this exploratory study, fully significant ($p < .05$) differences as well as trends toward significance ($p < .08$) were both noted.

Fourmillement (*pins and needles*). For *fourmillement*, differences between the groups were seen on three dimensions (see Figure 8), including intensity (strong-weak) $F(2,29) = 3.31$, $p = .051$, $\eta_p^2 = .186$; affect (calm-anxious) $F(2,29) = 3.46$, $p = .045$, $\eta_p^2 = .193$; and depth (deep-shallow) $F(2,29) = 3.61$, $p = .040$, $\eta_p^2 = .199$. For the intensity dimension, pairwise comparisons showed that the low proficiency L2 group ($M = 4.67$, $SD = 1.5$) had an understanding of the word as stronger in intensity than did the native L1 group ($M = 6.20$, $SD = 0.92$) ($p = .016$). The high proficiency L2 group's rating ($M = 5.46$, $SD = 1.4$) ($p = .187$), was closer to the mean of the native speakers and not significantly different from them. For the word *fourmillement* on the affective dimension, pairwise comparisons showed that the low proficiency L2 group ($M = 4.78$, $SD = 1.5$) again had an understanding of the word as more anxious than did the native L1 group ($M = 3.10$, $SD = 1.1$) ($p = .015$). Finally, for the depth dimension, pairwise comparisons showed that the low proficiency L2 group ($M = 3.78$, $SD = 2.1$) understood the word as deeper as well as the high proficiency L2 group ($M = 4.46$, $SD = 1.85$) ($p = .014$) showing a trend toward a similar deeper rating than did the native L1 group ($M = 5.80$, $SD = 0.63$) ($p = .069$).

Picotement (*prickling*). For the word *picotement*, differences between the groups were seen on two dimensions (see Figure 9), which were the dimensions of intensity

(strong-weak) $F(2,29) = 5.81$, $p = .008$, $\eta_p^2 = .286$; and affect (calm-anxious) $F(2,29) = 4.85$, $p = .015$, $\eta_p^2 = .251$. For the intensity dimension, pairwise comparisons showed that the low proficiency L2 group ($M = 4.33$, $SD = 1.9$) had a less intense rating for *picotement* than did the high proficiency L2 group ($M = 5.85$, $SD = 1.4$) as well as the native L1 group (p = .002) ($M = 6.5$, $SD = 0.5$) ($p = .02$). This indicated that for the word *picotement*, the intensity dimension was clearly not understood by the low proficiency group, but showed closer to native-like understanding for the high proficiency group. For this word on the affective dimension, however, both low and high proficiency L2 groups showed some misunderstanding as compared to the native speakers. Here, pairwise comparisons showed that the low proficiency L2 group had clearly significant higher ratings ($M = 4.44$, $SD = 1.3$) than the native L1 group ($M = 2.4$, $SD = 1.2$) ($p = .004$), indicating that native speakers thought the word *picotement* meant a calmer type of pain. The high proficiency L2 group, sat in a middle ground ($M = 3.54$, $SD = 1.6$) ($p = .07$), with a difference close to significant from the native L1 group.

Coup de Poignard (*stabbing*). For *coup de poignard*, the three dimensions of intensity (strong-weak) $F(2,29) = 3.79$, $p = .034$, $\eta_p^2 = .207$; temporal (constant-intermittent) $F(2,29) = 3.67$, $p = .038$, $\eta_p^2 = .007$; and depth (deep-shallow) $F(2,29) = 4.65$, $p = .018$, $\eta_p^2 = .243$, showed differences between the groups (see Figure 10). For the intensity dimension, pairwise comparisons showed that the high proficiency L2 group ($M = 3.23$, $SD = 1.9$) understood *coup de poignard* as weaker than did the native speakers ($M = 1.40$, $SD = 0.66$) ($p = .01$). For the depth dimension, pairwise comparisons showed that the high proficiency L2 group ($M = 4.08$, $SD = 2.4$) understood *coup de poignard* as more shallow than did the native speakers ($M = 1.40$, $SD = 0.84$) ($p = .005$). Finally, for

the temporal dimension, native speakers saw *coup de poignard* as more constant (M = 2.50, SD = 1.9) than both the high proficiency L2 group (M = 4.92, SD = 2.1) and the low proficiency L2 group (M = 4.44, SD = 2.5) (p = .014) with a difference close to significant from the native L1 group (p = .064).

Élancement (*shooting, twinge*). For the word *élancement*, differences in understanding between native and L2 groups were found on three dimensions, including the affective dimension (calm-anxious) $F(2,29) = 3.08$, $p = .061$, $\eta_p^2 = .175$; speed dimension (fast-slow) $F(2,29) = 2.979$, $p = .067$, $\eta_p^2 = .170$; and movement dimension (stable-moving) $F(2,29) = 4.01$, $p = .029$, $\eta_p^2 = .217$ (see Figure 11). For the affective dimension, pairwise comparisons showed that high (M = 5.08, SD = 1.3) (p = .024) and low proficiency (M = 4.89, SD = 0.7) L2 groups understood *élancement* as more anxious than did native speakers (M = 3.80, SD = 1.5) (p = .074). For the speed dimension, native L1 speakers understood *élancement* as being slower (M = 5.30, SD = 1.3) than both high (M = 3.69, SD = 2.0) (p = .041) and low (M = 3.56, SD = 1.8) (p = .043) proficiency L2 groups. Finally, for the movement dimension, native L1 speakers (M = 2.00, SD = 0.6) understood *élancement* as being significantly more stable than did the L2 high (M = 3.69, SD = 1.4) (p = .018) and low (M = 3.78, SD = 2.3) (p = .022) proficiency speakers.

Pincement (*pinching out*). For the word *pincement*, differences in understanding between the low proficiency L2 group and the native L1 speakers were found on three dimensions: the temporal dimension (constant-intermittent) $F(2,29) = 6.16$, $p = .006$, $\eta_p^2 = .298$; speed dimension (fast-slow) $F(2,29) = 2.57$, $p = .094$, $\eta_p^2 = .151$; and the movement dimension (stable-moving) $F(2,29) = 5.11$, $p = .013$, $\eta_p^2 = .251$ (see Figure 12). For the temporal dimension, pairwise comparisons showed that native L1 speakers

viewed the word *pincement* as more intermittent ($M = 4.70$, $SD = 1.7$) and the low proficiency L2 ($M = 3.22$, $SD = 1.7$) ($p = .057$), as more constant. For the speed dimension, pairwise comparisons showed that native L1 speakers viewed the word *pincement* as faster ($M = 2.50$, $SD = 1.5$), and the low proficiency L2 ($M = 4.33$, $SD = 2.3$) ($p = .034$) as slower. For the movement dimension, pairwise comparisons showed that native L1 speakers viewed the word *pincement* as less stable ($M = 4.90$, $SD = 1.8$), and the low proficiency L2 ($M = 2.00$, $SD = 1.5$) ($p = .003$) as more stable.

Tiraillement (*gnawing, tightness*). For the word *tiraillement*, differences in understanding between groups were found in the affective dimension (calm-anxious) $F(2,29) = 4.44$, $p = .021$, $\eta_p^2 = .235$ (see Figure 13). Pairwise comparisons show that the low proficiency L2 group rated the word *tiraillement* as more anxious ($M = 5.22$, $SD = 0.8$) than both the native L1 speakers ($M = 3.90$, $SD = 0.9$) ($p = .006$) as well as the high proficiency L2 group ($M = 4.38$, $SD = 1.0$) ($p = .057$).

Insupportable (*unbearable*). For the word *insupportable*, no differences were found in understanding on any of the dimensions between groups (see Figure 14).

Énervante (*irritating*). For the word *énervante*, differences between groups were found on the affective (calm-anxious) $F(2,29) = 3.11$, $p = .060$, $\eta_p^2 = .177$, and movement (stable-moving) $F(2,29) = 4.76$, $p = .016$, $\eta_p^2 = .247$ dimensions (see Figure 15). For this word, pairwise comparisons showed that differences were only found between the high proficiency L2 group and the native L1 speakers. On the affective dimension, the high proficiency L2 group found the word *énervante* to be more anxious ($M = 5.46$, $SD = 1.5$) than did the native L1 speakers ($M = 3.80$, $SD = 1.5$) ($p = .020$). On the movement dimension, the high proficiency L2 group found the word *énervante* to be less stable (*M*

= 4.92, *SD* = 2.0) than did the native L1 speakers (*M* = 3.00, *SD* = 1.4) (*p* = .016).

Épuisante (*exhausting*). For the word *épuisante*, differences between groups were found on two dimensions: intensity (strong-weak) $F(2,29) = 3.47$, $p = .044$, $\eta_p^2 = .193$, and affective (calm-anxious) $F(2,29) = 3.14$, $p = .058$, $\eta_p^2 = .178$ (see Figure 16). Upon pairwise analysis of the intensity dimension, native L1 speakers found the word *épuisante* to be weaker (*M* = 3.70, *SD* = 1.5) in intensity than did both the low proficiency L2 group (*M* = 2.11, *SD* = 1.0) (*p* = .023) and the high proficiency L2 group (*M* = 2.38, *SD* = 1.6) (*p* = .038). Pairwise analysis of the affective dimension found that native L1 speakers found the word *épuisante* to be calmer (*M* = 5.00, *SD* = 1.2) than the high proficiency L2 group (*M* = 4.10, *SD* = 1.3) (*p* = .018). Further pairwise comparisons revealed that differences were also found on the speed dimension, where native L1 speakers rated *épuisante* as being slower (*M* = 5.90, *SD* = 1.4) than the high proficiency L2 group (*M* = 4.23, *SD* = 2.1) (*p* = .048), and in the spatial dimension, where native L1 speakers rated it as being marginally more diffuse (*M* = 5.20, *SD* = 1.4) than the low proficiency L2 group (*M* = 3.56, *SD* = 1.8) (*p* = .079).

Angoissante (*harrowing*). For the word *angoissante*, differences between groups were found on the depth (deep-shallow) $F(2,29) = 3.40$, $p = .047$, $\eta_p^2 = .190$; thermal (cold-hot) dimensions $F(2,29) = 3.51$, $p = .043$, $\eta_p^2 = .195$; and spatial dimensions (localized-diffuse) $F(2,29) = 3.23$, $p = .054$, $\eta_p^2 = .182$ (see Figure 17). Pairwise analysis of the depth dimension showed that both native L1 speakers (*M* = 3.40, *SD* = 1.7) (*p* = .048) and the high proficiency L2 group (*M* = 3.62, *SD* = 2.0) (*p* = .019) found the word *angoissante* to be less deep than did the low proficiency L2 group (*M* = 1.78, *SD* = 1.1). Pairwise analysis of the thermal dimension showed that native L1 speakers found the

word *angoissante* to be colder ($M = 3.50$, $SD = 1.35$) than did both the low proficiency L2 group ($M = 4.89$, $SD = 1.4$) ($p = .028$) as well as the high proficiency L2 group ($M = 4.77$, $SD = 1.2$) ($p = .029$). Further pairwise analyses found that on the temporal dimension, native L1 speakers found the word *angoissante* to be less constant ($M = 3.10$, $SD = 1.3$) than did the low proficiency L2 group ($M = 1.56$, $SD = 0.8$) ($p = .038$). Also, in the movement dimension, native L1 speakers found it to be marginally less stable ($M = 4.30$, $SD = 1.7$) than did the low proficiency L2 group ($M = 2.56$, $SD = 1.7$) ($p = .059$). Finally in the spatial dimension, native L1 speakers found the word *angoissante* to be more diffuse ($M = 4.60$, $SD = 1.9$) than the low proficiency L2 group who found it to be more localized ($M = 2.44$, $SD = 1.8$) ($p = .032$).

Brûlement (*burning*). For the word *brûlement*, no differences were found in understanding on any of the dimensions between groups (see Figure 18).

Overall L2/Native speaker matching of dimensions

To examine which dimensions matched best with native French speakers and which were least matching by the L2 groups (which could indicate misunderstandings), the total amount of significant ($p < .05$) and close to significant ($p < .08$) differences (which indicated nonmatching with native French speakers) in mean ratings between the native L1 French group and the L2 French groups were aggregated by each of the eight dimensions measured (see Table 6). The most matching dimensions overall were "thermal" (nonmatching on one word each by low and high proficiency L2 groups) and "depth" (nonmatching on two words by the low proficiency L2 group). The least matched (and possibly least understood) dimension overall was "affective" (nonmatching on four words by the low proficiency L2 group and five words by the high proficiency L2

group). The second worst overall was "intensity" (nonmatching on three words by the low proficiency L2 group and two by the high proficiency L2 group). Overall, differences by proficiency indicate that when the eight dimensions for each of the 11 stimuli words were aggregated and collapsed together, that the low proficiency L2 group had 21 nonmatching dimensions (out of a possible total of 88 dimensions) across the pain-word stimuli, while the high proficiency L2 group had 12 nonmatching dimensions across the pain-word stimuli.

Examining differences of meaning in close translation-equivalents

To explore the hypotheses predicted from the revised hierarchical model (RHM) (Kroll & Stewart, 1994) in regard to vocabulary acquisition in an L2, analyses were performed on pairs of close translation-equivalent words in English and French. The developmental hypothesis of the RHM postulates that beginners in a language mediate the conceptual meaning of L2 vocabulary through their close L1 translation equivalent. Therefore, the RHM would predict no differences in nuanced semantic meaning between translation-equivalents between an L1 and L2 for beginners, even when native speakers note differences. To test this hypothesis, each pair of close translation-equivalent pain words in French and English was examined for each of the three levels of proficiency separately. Out of the original 11 cross-linguistic pairs of pain-word stimuli, only nine pairs qualified as valid close translation-equivalents, as defined as direct dictionary translations.

The analyses performed were MANOVAs isolating each group by proficiency level, looking for differences in ratings on each dimension (see Table 5) between the French and English pairs of close translation-equivalent pain words. Then, the results for

the groups were examined together to look for the pattern predicted by the RHM. Since the L1 French-native speaking participants were all at a high level of proficiency in English, their results on the nuanced semantic differences between the English and French close translation-equivalents were used as the reference point to which the low and high proficiency L2 French participants were compared.

Picotement vs. Stinging. The French L1 native group found that these words differed on three dimensions: that of "intensity," "spatial," and "affective." On the intensity dimension, *stinging* was considered stronger ($M = 4.6$, $SE = 0.31$) than *picotement* ($M = 6.5$, $SE = 0.31$) ($F(1,18) = 19.23$, $p < .001$, $\eta_p^2 = .516$). On the spatial dimension, *picotement* was considered more diffuse ($M = 4.0$, $SE = 0.48$) and *stinging* more concentrated ($M = 1.5$, $SE = 0.48$) ($F(1,18) = 13.24$, $p = .002$, $\eta_p^2 = .424$). On the affective dimension, *stinging* was considered more anxious ($M = 4.4$, $SE = 0.39$), and *picotement* more calm ($M = 2.4$, $SE = 0.39$) ($F(1,18) = 13.43$, $p = .002$, $\eta_p^2 = .427$). The L2 low proficiency group saw no significant ($p < .05$), or close to significant ($p < .08$) differences on any of the dimensions between these two words. The L2 high proficiency group, however, found differences in meaning on two dimensions (intensity, movement) between each of these words. On the intensity dimension, parallel to the L1 native group's ratings, *stinging* was considered stronger ($M = 4.3$, $SE = 0.47$) than *picotement* ($M = 5.9$, $SE = 0.47$) ($F(1,24) = 5.39$, $p = .029$, $\eta_p^2 = .183$). On the movement dimension, *stinging* was considered more stable ($M = 3.54$, $SE = 0.52$) than *picotement* ($M = 5.15$, $SE = 0.52$), a difference not recognized by the native L1 French group ($F(1,24) = 4.79$, $p = .039$, $\eta_p^2 = .166$).

Fourmillement vs. Tingling. The French L1 native group judged these two words as equivalent on all the dimensions as did the high proficiency L2 group. The low proficiency L2 group, however, saw differences between these two words on the affective dimension, intensity dimension and depth dimension. For the affective dimension, the low proficiency L2 group saw the word *tingling* as calmer ($M = 2.1$, $SE = 0.44$) than the word *fourmillement* ($M = 4.8$, $SE = 0.44$) ($F(1,16) = 18.00$, $p = .001$, $\eta_p^2 = .529$). For the intensity dimension, they saw the word *tingling* as weaker ($M = 6.8$, $SE = 0.37$) than *fourmillement* ($M = 4.6$, $SE = 0.37$) ($F(1,16) = 16.41$, $p = .001$, $\eta_p^2 = .506$). Finally, for the depth dimension, the low proficiency L2 group saw the word *tingling* as more shallow ($M = 6.3$, $SE = 0.54$) than *fourmillement* ($M = 3.7$, $SE = 0.54$) ($F(1,16) = 11.32$, $p = .004$, $\eta_p^2 = .414$).

Élancement vs. shooting. The French L1 native group judged these two words as different in five dimensions: intensity ($F(1,18) = 12.90$, $p = .002$, $\eta_p^2 = .418$); movement ($F(1,18) = 4.46$, $p = .049$, $\eta_p^2 = .199$); spatial ($F(1,18) = 7.79$, $p = .012$, $\eta_p^2 = .302$); and affective ($F(1,18) = 9.80$, $p = .048$, $\eta_p^2 = .200$). The high proficiency L2 group judged these two words as different on two dimensions of temporal ($F(1,24) = 7.15$, $p = .013$, $\eta_p^2 = .230$), and spatial ($F(1,24) = 20.34$, $p = .034$, $\eta_p^2 = .175$), and marginally different on the dimensions of movement ($F(1,24) = 3.75$, $p = .065$, $\eta_p^2 = .135$), and depth ($F(1,24) = 3.57$, $p = .071$, $\eta_p^2 = .129$). The low proficiency L2 group judged these two words as different on the movement ($F(1,16) = 5.11$, $p = .038$, $\eta_p^2 = .242$), and speed dimensions ($F(1,16) = 6.39$, $p = .022$, $\eta_p^2 = .285$), and marginally different on the spatial ($F(1,16) = 3.66$, $p = .074$, $\eta_p^2 = .186$), and affective ($F(1,16) = 4.00$, $p = .063$, $\eta_p^2 = .200$) dimensions.

Coup de Poignard vs. Stabbing. The French L1 native group found these two words to be marginally different on the dimension of depth ($F(1,18) = 3.60$, $p = .074$, $\eta_p^2 = .167$). The high proficiency L2 group found the same dimension of depth to be significantly different between the words in the two languages ($F(1,24) = 4.53$, $p = .044$, $\eta_p^2 = .159$). The low proficiency L2 group, however, did not recognize any differences between the two words, seeing them as equivalent on all dimensions.

Pincement vs. Pinching. The French L1 native group found these two words to be different on the dimension of movement ($F(1,18) = 6.10$, $p = .024$, $\eta_p^2 = .253$). Both high and low proficiency L2 groups did not find this or any other difference between the two words.

Brûlement vs. Burning. All groups agree on the equivalence on all dimensions for these two words.

Angoissante vs. Agonizing. For these two words, the French native L1 group found differences in three dimensions: intensity ($F(1,18) = 8.27$, $p = .010$, $\eta_p^2 = .315$); temporal ($F(1,18) = 5.45$, $p = .031$, $\eta_p^2 = .232$); and movement ($F(1,18) = 5.55$, $p = .030$, $\eta_p^2 = .236$). Both high and low proficiency L2 groups did not find these or any other difference between these two words.

Énervante vs. Annoying. For these two words, the French native L1 group found a difference in the intensity dimension ($F(1,18) = 7.68$, $p = .013$, $\eta_p^2 = .299$). The high proficiency L2 group did not match in their differences, finding a difference in the affective dimension ($F(1,24) = 4.55$, $p = .043$, $\eta_p^2 = .159$), and a marginal difference in the speed dimension ($F(1,24) = 4.18$, $p = .052$, $\eta_p^2 = .148$). The low proficiency L2 group did not find any differences between these two words.

Insupportable vs. Unbearable. For these two words, the French native L1 group found a difference on the depth dimension ($F(1,18) = 6.04$, $p = .024$, $\eta_p^2 = .251$). The high proficiency L2 group also found a difference (albeit marginally) on the same dimension of depth ($F(1,24) = 3.28$, $p = .079$, $\eta_p^2 = .119$). The low proficiency L2 group found no differences on any dimension between these two words.

Tiraillement vs. Cramping. For these two words, the French native L1 group saw differences in three dimensions: temporal ($F(1,18) = 16.71$, $p = .001$, $\eta_p^2 = .481$); spatial ($F(1,18) = 17.74$, $p = .001$, $\eta_p^2 = .496$); and affective ($F(1,18) = 5.69$, $p = .028$, $\eta_p^2 = .240$). The high proficiency L2 group saw differences as well on the spatial dimension ($F(1,24) = 6.88$, $p = .015$, $\eta_p^2 = .223$), and also marginally on the affective dimension ($F(1,24) = 4.17$, $p = .052$, $\eta_p^2 = .148$). The low proficiency L2 group found no such differences between the words ‘tiraillement’ and ‘cramping.’

Discussion

This research project had two main goals. The first was to examine what misunderstandings may occur when describing pain sensations verbally in a L2, and how these misunderstandings could impact an evaluative instrument such as the McGill Pain Questionnaire, which relies upon finely tuned categories and sub-categories of pain-descriptor words (rank-ordered within each sub-category by intensity). This was accomplished by comparing semantic-differential rankings of native-L1 speakers with L2 speakers, and it was found that out of the eight semantic-differential dimensions examined (see Table 5), that the affective and intensity dimensions (which are both important in the organization, and thus the effectiveness of the McGill Pain

Questionnaire) are the least well matched with native speakers, and possibly the most misunderstood.

Secondly, cross-linguistic translation equivalent word pairs were compared to examine support for or against current hypothetical models of L2 vocabulary acquisition. The results of these comparisons support an underlying semantic structure with conceptual elements or features (some of these features being shared between translation equivalents while some are not) similar to what the distributed feature model (DFM) proposes (see Figure 4). However, the results also bring to light the need for developmental refinements to this model; for example, developmental aspects of the revised hierarchical model (RHM), such as the proposal that for beginners, lexical/conceptual access is mediated through the L1 close-translation equivalent, and as proficiency in the L2 increases, that there is eventual development of, and direct access to, independent L2 concepts.

Pain-word semantic dimensions comprehension

The results of the L2-French speakers' judgments of the French language pain-descriptor words in comparison to native L1 French speakers revealed which of the semantic-differential dimensions are the easiest and the hardest to grasp when using pain-vocabulary in a second language. The affective dimension was the most commonly nonmatched, as could be explained by the fact it is the most subtle, least concrete and least physical of all the semantic-differential dimensions used (given that the other dimensions described concrete aspects of the physical sensation, rather than more abstract emotional or psychological states). Of the remaining more concrete semantic-differential dimensions, the dimension of intensity was the one with the most nonmatchings across

the pain-word stimuli. Although the nonmatchings were almost half the rate on this dimension than the affective dimension, intensity is a dimension of particular importance in the use of verbal measures of pain, such as the MPQ. Given the importance of accurately being able to communicate precise levels of pain intensity in a second language, providing greater emphasis on these nuanced differences of pain-vocabulary in language training to health-care practitioners and patients alike could be useful. This could perhaps be at least partly accomplished by presenting pain word vocabulary lists with words arranged in rank order of intensity.

Dimension comprehension by proficiency. To investigate potential progress in semantic understanding of pain word vocabulary, it is useful to compare the low and high proficiency groups separately. The total nonmatching semantic-differential dimensions (i.e., where ratings by the L2 speakers did not match that given by L1 speakers) across the pain-words indicate that the high proficiency L2 group had almost half of the nonmatchings compared to the low proficiency L2 group. This would appear to indicate a trend: as proficiency in a second language increases, understanding of the nuanced semantic meaning of vocabulary (at least for pain descriptor vocabulary) moves closer to that of native speakers, as one might expect. This not only provides validity to the proficiency split used here, but also provides validity to the semantic-differential methodology as a tool for evaluating the nuanced semantic dimensions understanding of words. Examining the nature of the difference between the low proficiency L2 group and the high proficiency L2 group on matching dimensions, we can see that improvement is greatest among the more concrete dimensions, whilst the least-concrete dimension (affective) is the only dimension with no improvement as proficiency increases (Van Hell

& de Groot, 1998). This indicates that even the L2 speakers with the most experience and ability are progressing at the language without picking up on the subtle affective connotations of these pain-descriptor words. Examining a wider-in-scope, less-specialized list of affectively tinged vocabulary might reveal if this lack of progress is a general issue whose importance could reach beyond that of communicating about pain in a L2. Finding a way to teach native-like understanding of affective semantic nuance (perhaps instruction focusing on gradations of this dimension for each word, or a method based more on context-based learning instead of memorization of dictionary-like vocabulary lists) should allow progress to be made in this regard, where it appears current classroom and immersive learning experience seems to be lacking.

This methodology (with further investigation into its potential use as an evaluative tool, perhaps including more dimensions which are less-concrete in nature, such as cultural connotations and more affective aspects than just *calm* - *anxious*), could possibly be developed and tested for reliability for use as an adjunct quantitative measure of fluency. This would allow nuanced semantic understanding of L2 vocabulary to be compared with that of native L1 speakers to assess what could possibly be a deeper marker of fluency than, say, measuring hesitation-free speech rate.

Cross-language word pair comparison

The examination of differences by proficiency level of the cross-linguistic (French and English) semantic-differential dimensions between close-translation pairs with the pain-word stimuli provides some insight into the process of L2 vocabulary acquisition. In contrast to most of the previous work done examining bilingual semantic memory, which has primarily looked at speed (RT) of translations to and from the L1

(Kroll & Stewart, 1994; Van Hell & de Groot, 1998), the present experiment examined semantic memory by attempting to measure features (dimensions) of the semantic concepts directly from self-report. The main focus of the current investigation was to examine if beginning L2 speakers have a tendency to think of new L2 vocabulary as exact translation equivalents, with the same nuanced denotative and denotative meanings as the close-translation L1 equivalent. This type of conceptual understanding, similar to the early word-association models of L2 vocabulary (Lambert et al., 1958), is expected in beginner L2 speakers according to hypothetical models of L2 vocabulary acquisition such as the RHM (Kroll & Stewart, 1994). Given that simple dictionary word lookup and language textbook's vocabulary wordlists are a common method of learning new vocabulary, it would not be surprising to equate a one-to-one meaning between close-translation equivalents. However, not all close-translation word pairs across two languages have exactly the same nuanced levels of meaning, especially more abstract vocabulary such as pain-descriptor vocabulary (de Groot, 1992), as has been confirmed by the results here by the semantic-differential judgments by native French speakers who are also close to balanced bilinguals, fluent also in English. Out of ten pairs of pain-word descriptors deemed to be close-translation equivalents, eight of the ten pairs (80%) were judged by the balanced bilinguals to be different on at least one of the semantic-differential dimensions examined.

Given that the French L1 group was composed of fluent L2 English speakers, their judgments here concerning the close-translation equivalents were considered the most accurate bilingual understanding of semantic nuanced differences between the pair of words. Thus, comparing the native L1 English speakers at two levels of proficiency in

L2 French (where the high proficiency L2 French group did not approach the fluency in L2 English of the L1 French group) provided a standard from which significant differences in judgment could be obtained.

Developmental differences in L2 pain word semantic understanding

The main hypothesis of interest here is whether the results provide support for the developmental hypotheses of the RHM (Kroll & Stewart, 1994), which postulates that vocabulary for a L2 starts for beginners by initially borrowing semantic meaning from a close-translation equivalent in the L1, known as concept mediation. The RHM also predicts that advanced L2 speakers, who are higher in proficiency, eventually develop a separate semantic concept for L2 including any variations in nuanced meaning that a native L1 speaker of the language might have. In addition, models such as the distributed features model (DFM) (de Groot, 1992; Van Hell & de Groot, 1998), which states that close-translation equivalents across languages can share some or all of semantic features (see Figure 4), yet do not have clearly stated developmental models of how these semantic features are acquired, might provide some expectation that the process of balanced bilingual understanding of these nuances might be a progressive process.

To explore the expected pattern predicted (primarily) from the RHM hypothesis using the semantic-differential ratings, one would expect that in the cases where L1 native speakers find differences (relevant to 80% of the pairs examined here), that the low proficiency L2 group will find no differences, and the high proficiency L2 group's ratings should be closer to the native speakers'.

Anomalous translation pairs. Out of the total 10 pairs of close-translation equivalents, only one pair (*fourmillement – tingling*) displayed a pattern that ran counter

to what would be expected from the developmental RHM hypothesis of vocabulary acquisition, and this pair was rated as equivalent by the native L1 French group on all eight dimensions examined here. In this case, the low proficiency L2 group "mistakenly" thought there were differences on three of the dimensions, while the high proficiency L2 group was in accord with exact equivalence of these two words (see Figure 19). A pattern similar to this might be expected as an alternative hypothesis to the RHM, where instead of mediating the L2 lexeme through the L1 concept, a new concept would be formed initially with new vocabulary, albeit not very accurate (perhaps almost random), yet increasing in accuracy along with proficiency. This would be similar to a developmental version of the old coordinate model of vocabulary acquisition, which also postulates that a new separate concept is formed for L2 vocabulary even for beginners rather than (what the RHM proposes) initially mediating through the L1 equivalent (Lambert, et al., 1958). However, the simplest explanation for the results of this aberrant word pair could be that the low proficiency group was not familiar enough with the meaning of the word *fourmillement* to know that it was sufficiently similar to *tingling*. Supporting this explanation are the results of the pain-word recognition task, where 62% of the low proficiency L2 group did not correctly identify *fourmillement* as a word that would be commonly used to describe a sensation of pain. Further support for this explanation can be found by looking at the data from the matching dimensions analysis (see Figure 8), where we can see that for the word *fourmillement*, the three dimensions the low proficiency L2 speakers did not grasp (that of intensity, affective, and depth) were the same three dimensions off-target from the more proficient French speakers in the cross-linguistic word-pair judgments (for *fourmillement – tingling*).

The other word-pair that was judged by native French L1 speakers to be an exact equivalent on the eight semantic-differential dimensions examined here was *brûlement – burning* (see Figure 20). In this case, the relationship to the hypothesis is inconclusive in that all three groups recognized perfect correspondence between the two words. This could be due to the clear and concrete understanding of what it feels like to burned, which most people will have some experience of in their lives. Further evidence that the meaning of the French word *brûlement* was easy to understand for even low proficiency L2 speakers can be seen in the matching dimension analysis, where both levels of L2 proficiency rated the word effectively the same as the native L1 speakers of French (see Figure 18). Given the concrete nature of this sensation, the lack of differences in nuance, and ease of understanding fits with what the DFM would expect from concrete words (Van Hell & de Groot, 1998).

The final anomaly from the group of word pairs was *élancement – shooting*. The native-French L1 group saw these words as different from each other on five of the eight semantic-differential dimensions examined (see Figure 21). This word pair had the greatest number of differences noted by native-speakers, greater than between any of the other close-translation equivalent pairs. To compare, the next largest amount of difference between any of the other word-pairs as ranked by the native L1 French speakers was at most three dimensions. This is a good indicator that this pair of words is not a close enough translation equivalent. In this particular case, the L2 speakers from both high and low proficiency levels all recognized that these words were different on four of the dimensions explored (see Figure 11), recognizing that these words are not that similar, yet there was some confusion as to which of the dimensions they differed on.

Despite shooting pain being an important pain-descriptor used in the English MPQ, there appears to be no close-translation equivalent for it in French (although the variant *lancinant* could be a little bit closer).

Final set of close translation pairs. The remaining seven cross-linguistic word-pairs, which were close-enough translation equivalents (ranked by French L1, yet balanced bilinguals as being different on three or less dimensions) and seemed not to have the qualities of being too easy or too hard to understand, provide better material for analyzing the hypotheses raised by the RHM and DFM. The majority of these remaining word-pairs (four out of those seven) showed both clear L1 lexical linkage (perceived exact translation-equivalence) for the low proficiency L2 group and an improvement in the high proficiency L2 group (defined as recognizing some or all of the semantic-differential dimensional differences that the native speakers agreed upon). These four word-pairs (see Figures 22-25) provide the clearest evidence supporting the RHM hypotheses that beginners use lexical linkage/word association for L2 vocabulary from close-translation equivalents in their L1, and that as L2 learners become more advanced, they develop separate, and more native-like concepts (Kroll & Stewart, 1994). Looking at these pairs from the perspective of the DFM (de Groot, 1992), it appears that low proficiency L2 speakers have a clear pattern of linking their L2 vocabulary with all of the semantic features of their L1 close-translation equivalent, and as proficiency increases, there is greater native-like understanding of the nuanced differences between the words, with some semantic feature differences correctly identified, and some mistaken differences present (see Figures 22-25).

In addition, the other three word-pairs out of those seven pairs all display exact translation-equivalence for the low proficiency L2 group (again implying lexical linkage of the L2 lexeme with the L1 concept), except with no improvement for the high proficiency L2 group. In these three instances (see Figures 26-28), for two of the word-pairs the high proficiency L2 group also sees exact translation-equivalence (still have not grasped that there are nuanced differences) and for one word-pair *énervante – annoying*, (see Figure 26) they see confused differences that don't correspond at all with the native speakers (appear to be developing separate, yet still inaccurate concepts). While these three instances do not perfectly follow what would be expected from the developmental RHM-based hypotheses, they certainly do not invalidate it. For the two instances where the advanced L2 group still are using mediating meaning through the L1 (*pincement - pinching*, and *angoissante - agonizing*), it could just be that the differences in these pairs are sufficiently subtle that the high proficiency L2 group was not culturally fluent enough (yet) to begin to distinguish them (see Figures 27-28).

For the other instance (*énervante – annoying*), the low proficiency speakers saw exact translation equivalence, and the French L1 native speakers saw a difference in the two words in that *énervante* was seen as less intense than *annoying*. The high proficiency L2 group, however, thought that there where differences between the two words on the affective and speed dimensions, and not intensity (see Figure 26). This indicates that the more advanced L2 speakers did see differences (thus possibly having developed basic separate concepts) but were not yet accurate as what those differences were (when compared with native L1 speakers). This could be possibly attributed to an initial stage

of L2 vocabulary separate concept development, where there is a sense of difference, but confusion as to what those differences are exactly.

To summarize, there seems to be support for the developmental aspect of the RHM that postulates that L2 beginners use the close-translation equivalent concept from their L1, and as they advance, begin to directly link the L2 vocabulary to a separate, yet possibly overlapping concept (perhaps somewhat like the coordinate model). Given the use of semantic-differential dimensions (as opposed to the previous use of translation speed (de Groot, 1992; Kroll & Stewart, 1998)), these results reveal more detail in the process of L2 vocabulary acquisition than the RHM deals with. In this case this allows for some support for the DFM and its semantic features model. Given the predictions of the DFM, it seems clear that in the case of the most 'concrete' of these word-pairs (*brûlement – burning*) the predicted sharing of all semantic features (Van Hell & de Groot, 1998) at all levels of proficiency is supported. For the majority of the word-pairs examined, it becomes clear that the DFM should integrate something of the developmental aspect of the RHM, in that semantic features in L2 vocabulary are shared (often incorrectly with abstract sensations at least) with the L1 close-translation equivalents for beginners, and that specific features are distinguished as different in some sort of progression as proficiency increases.

The nature of this progression does raise some questions though. It is interesting that the differentiation of semantic features as proficiency increases includes some alignment to match that of the native-speakers, but also some apparently random changes away from L1 equivalence but not towards native-like understanding (see Figures 22-25). This could possibly imply that rather than semantic features being completely

independent of the larger concept (like the DFM suggests), there could be a transition from a common meaning (i.e. in the case of lexical or concept mediation) to a distinct meaning (for the L2 vocabulary), where the process of developing the newly formed distinct meaning for the L2 vocabulary introduces some chaos as it is formed. Alternately, if the DFM's independent features hypothesis is correct, the process of fine-tuning nuanced meaning in L2 vocabulary could involve some experimentation in semantic features as subtle understanding is often learned roughly through context. The overall progress from the low proficiency L2 to the high proficiency L2 group with a tendency to become closer to native L1 speakers does provide evidence that greater nuanced understanding is likely to go hand-in-hand with increasing proficiency, and is not as difficult, or as prone to "fossilization" in the lexical association mode, as proposed by Jiang (2000).

Conclusion

The results of this experiment provide insight into, and raise questions about, L2 vocabulary understanding on a number of levels. On one level, they raise concerns about using verbal diagnostic instruments (like the McGill Pain Questionnaire) with L2 speakers, and identify some weaknesses in L2 semantic understanding (within a limited scope at least) that could possibly be addressed with a pedagogical approach focusing on teaching cultural nuance, especially in critical areas, such as with pain-descriptor words for health-care workers in a bilingual setting or in French (or English) as a second-language courses for new immigrants. In addition, the methodology of using semantic-differential scales provides a new, and potentially useful measure of nuanced semantic fluency that traditional measures (subjective measures, rate of hesitation free-speech,

etc…) might not capture. As for advancing theoretical models of bilingual vocabulary acquisition, the results provide evidence for a model closely resembling the DFM, but with provisions for progression as proficiency in the L2 increases, perhaps integrating developmental hypotheses similar to what the RHM proposes about L1 mediation at the beginner level and separation of the L2 concept at more advanced levels.

Since this experiment is largely exploratory, it is therefore not surprising that it raises more questions than it answers; nevertheless, it appears to have been a fruitful line of inquiry. One aspect which is of concern in interpreting the results, however, is the power of the statistical analyses in regard to the sample size, since effectively the total sample of participants has been split into three for purposes of comparing French language proficiency levels. However, given the promising initial results of this exploratory methodology, it behooves future researchers to replicate this study with a larger participant pool.

With regard to the MPQ, this methodology would be directly capable of testing the validity of the intensity rankings of the pain-words in each sub-class to see if the rankings hold for low proficiency L2 speakers. With the right number of dimensions, cluster-analysis of native speakers' pain-word rankings could be used for validation of the classes and sub-classes themselves in new, or unvalidated translations of the MPQ. The semantic-differential dimension judgment methodology could also be used as a measure of nuanced native-like fluency in a specific vocabulary (such as with pain-words), and thus could be used to assess the effectiveness of a number of supplementary methods of language instruction to compensate for specific areas of weakness, such as understanding in the affective and intensity dimensions.

Regarding general bilingual vocabulary acquisition, the semantic-differential rating system could be calibrated as a general quantitative instrument for semantic concept research (Osgood has a general purpose set of dimensions in his original scale system, but it was not designed for this application specifically (Osgood, et al., 1965)). Since some of the greatest areas of difference amongst translation-equivalents is among abstract words, and in the social-context of their use (Van Hell & de Groot, 1998) perhaps adding more dimensions along the lines of the affective dimension (rural-urban, young-old, polite-rude) would provide richer information.

To explore developmental processes in the context of the DFM, using finer grained levels of proficiency than low and high L2 groups in combination with a solid set of dimensions to rank might give more insight into exactly how and when the semantic components switch over to native-like understanding from L1 mediation. Tailoring such an experiment to examine whether the semantic features are in one memory system, or the result of a switch from L1 concept mediation to the development of a separate L2 concept might help explain the presence of mistaken differences in the higher proficiency L2 group. Given the continued debate on methods of language learning and their impact on how we store L2 vocabulary, whether by immersion or classroom, (Altarriba & Heredia, 2008), examining whether differences in the developmental progress of semantic component changes exist between these groups would also be of great interest. Of course, given the exploratory nature of this methodology, simple replication of these results, and in a bidirectional fashion (French L1 – English L2 as well as English L1 – French L2) would be in order.

In conclusion, this research, and its use of the semantic-differential judgment paradigm for examining the process of L2 vocabulary development is promising in both its practical and theoretical usefulness. Practically, it has shown itself to be able to reveal weaknesses and limitations in L2 semantic understanding, allowing potential training to focus on these areas of weakness and have that semantic understanding be re-tested to determine its effectiveness. This methodological tool also shows potential as a nuanced measure of high-level native-like fluency. Theoretically, this methodology opens up the field for more detailed examination of how semantic understanding develops at what may be something close to the conceptual feature level as proposed by the DFM. This can allow for a plethora of investigations into developmental models of bilingual vocabulary acquisition and refinement of the DFM itself. This methodology holds promise for future researchers and for greater understanding of L2 semantic concept acquisition.

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Tables

Table 1

Stimuli – Closest Translation Equivalents

English descriptor words	French descriptor words	MPQ sub-classes
shooting	élancement	SPATIAL / TEMPORAL
throbbing	pulsante	TEMPORAL
stabbing	coup de poignard	INCISIVE PRESSURE
stinging	picotement	INCISIVE PRESSURE / BRIGHTNESS
tingling	fourmillement	DYSESTHESIAS / BRIGHTNESS
pinching	pincement	CONSTRICTIVE PRESSURE
cramping	tiraillement	TRACTION PRESSURE
unbearable	insupportable	INTENSITY / EVALUATIVE
annoying	énervante	TENSION
exhausting	épuisante	INTENSITY / AFFECTIVE / FATIGUE
agonizing	angoissante	INTENSITY / AFFECTIVE / ANXIETY
burning	brûlement	THERMAL

Note. Main list of 11 pain descriptor vocabulary in both English and French taken primarily from their respective translations of the MPQ.

Table 2

Initial Semantic Differential Dimensions (Part 1 of 2)

Sub-Class	English	Français	Osgood's factor
Intensity	Mild – Excrutiating	Léger – Atroce	
	Strong – Weak	Fort - Faible	potency
Temporality	Constant - Intermittent	Constant - Intermittent	
	Short – Long	Court – Long	potency
	Stable – Moving	Stationnaire – En movement	
Spatial	Fast – Slow	Rapide – Lent	activity
	Localized – Diffuse	Localisé – Diffuse	
	Deep – Shallow	Profond – Peu profound	potency
	Large – Small	Grand - Petit	potency
	Concentrated – Diluted	Concentré - Dilué	
Thermal	Cold - Hot	Froid – Chaud	activity

Note. Contrasting opposites to be used in combination with the pain descriptor words in the semantic differential task.

Table 2

Initial Semantic Differential Dimensions (Part 2 of 2)

Sub-Class	English	Français	Osgood's factor
Quality	Wet – Dry	Mouillez – Séchez	
	Black – White	Noir – Blanc	potency
	Soft – Hard	Doux – Dur	potency
	Calm – Anxious	Calme – Anxieux	activity
	Happy – Sad	Heureux – Triste	evaluative
	Tense – Relaxed	Tendu – Détendu	evaluative
Cultural	Young – Old	Jeune – Âgé	activity
	Urban – Rural	Urbain – Rural	
	Feminine – Masculine	Féminin – Masculin	
	Rude – Polite	Grossier – Poli	
	Understated – Exaggerated	Minimisé – Exagéré	
	Rich – Poor	Riche - Pauvres	evaluative
	Common - Rare	Common - Rare	

Note. Contrasting opposites to be used in combination with the pain descriptor words in the semantic differential task.

Table 3

LBQ-Person/Object task Correlations

Variables		p	r
Total French Time	French Medical Exp.	.034*	.454
Subjective French Rating	Total French Time	.068~	.396
Subjective French Rating	French Medical Exp.	.000**	.691
Subjective French Rating	L2 mean RT, residualized	.021*	-.488
L2 mean RT, residualized	French Medical	.050*	-.422
L2 cv, residualized	L2 mean RT, residualized	.003**	.597

Note. * = $p<.05$; ~ = $p<.08$; Exp. = Experience.

Table 4

2-Way split clusters

Variable	Low Proficiency (n=8)	High Proficiency (n=14)	p
L2 Mean RT (Res.)	128.8	-73.6	.000**
L2 RT CV (Res.)	.05	-.03	.007*
Subj. French Rating	13	16	.007*
Subj. French Med. Exp.	5	9	.039*

Note. * = $p<0.05$; ** = $p<0.001$; Res. = Residualized from respective L1 score; Subj. = Subective measure from LBQ; Clustering done by K-means clustering algorithm; remaining French L1 n=10.

Table 5

Final Set of Semantic Differential Dimensions

English Version	Dimension Represented
Strong - Weak	Intensity
Constant - Intermittent	Temporal
Stable - Moving	Movement
Fast - Slow	Speed
Localized - Diffuse	Spatial
Deep - Shallow	Depth
Cold - Hot	Thermal
Calm - Anxious	Affective

Note. See Table 2 for French versions of the semantic differential polar opposite pairs used.

Table 6.

Total Nonmatching Dimensions

Dimension	Low Proficiency (n=8)	High Proficiency (n=14)	Total L2 (n=22)
Affective	4	5	9
Intensity	3	2	5
Movement	3	1	4
Temporal	3	1	4
Speed	2	2	4
Spatial	3	0	3
Depth	2	0	2
Thermal	1	1	2

Note. Aggregated number of dimensions from all 11 stimuli words (in French) which did not match with that of Native L1 speakers.

Figures

McGill Pain Questionnaire pain-word descriptor classification structure:

<table>
<tr><th>Classes</th><th colspan="2">Sub-Classes</th></tr>
<tr><td rowspan="7">Sensory</td><td colspan="2">Temporal</td></tr>
<tr><td colspan="2">Spatial</td></tr>
<tr><td rowspan="3">Pressure</td><td>Incisive pressure</td></tr>
<tr><td>Constrictive pressure</td></tr>
<tr><td>Traction pressure</td></tr>
<tr><td colspan="2">Thermal</td></tr>
<tr><td colspan="2">Dysesthesias</td></tr>
<tr><td colspan="2">Dullness</td></tr>
<tr><td colspan="3">Affective</td></tr>
<tr><td colspan="3">Evaluative</td></tr>
</table>

Figure 1. McGill Pain Questionnaire pain-word descriptor classification structure. The descriptor words originally used in the MPQ have been categorised into belonging to exclusive Classes and Sub-Classes and each word within are further arranged by increasing levels of perceived intensity (Adapted from Melzack & Torgerson, 1971).

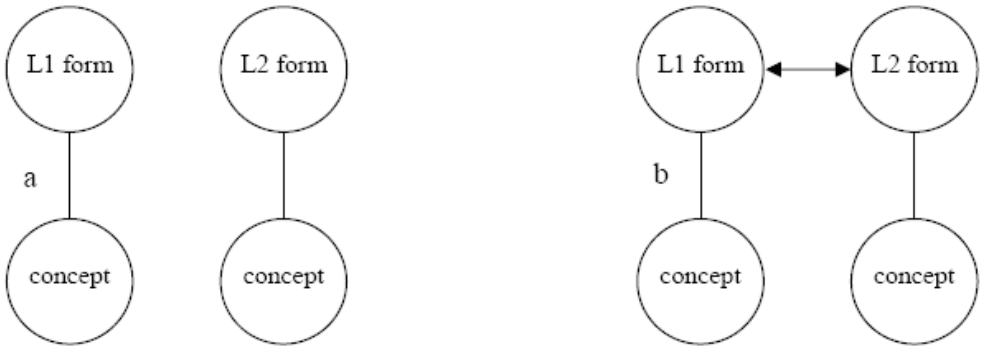

Figure 2. Distinct Meaning Models of lexical organization. a) coordinate model b) coordinate model showing interlingual connections (Finkbeiner, 2002)

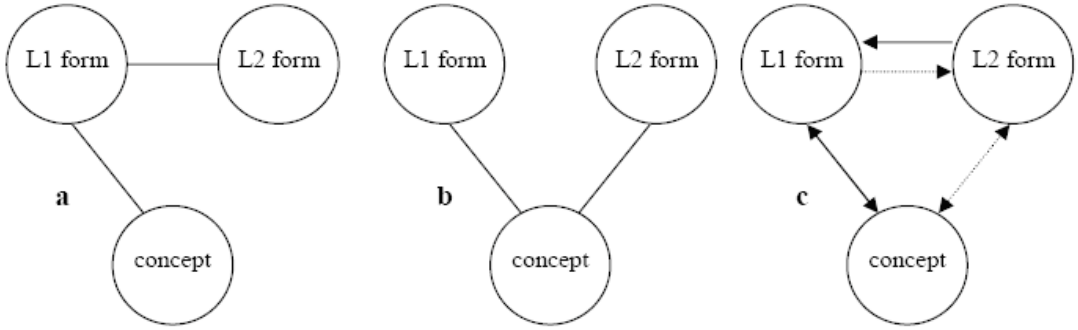

Figure 3. Common meaning models. a) word association model b) concept mediation model c) revised hierarchical model (Finkbeiner, 2002)

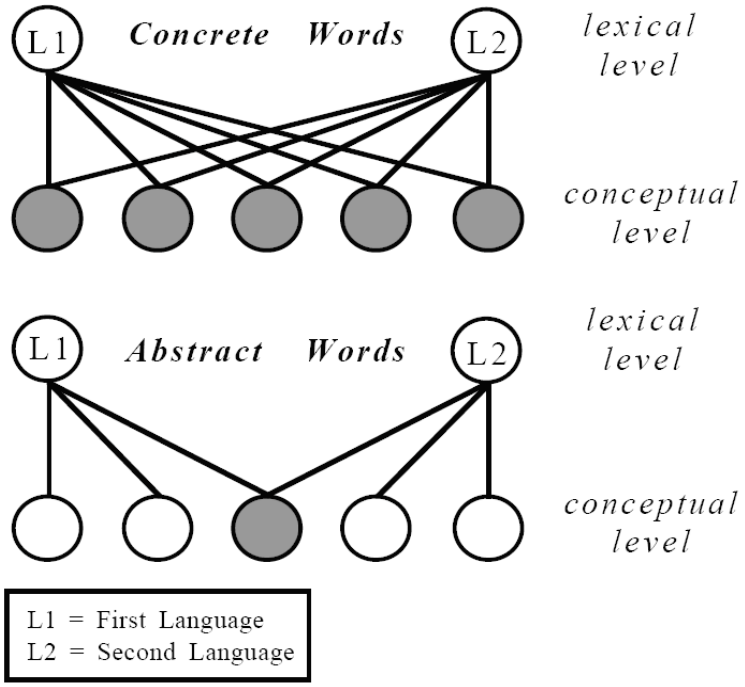

Figure 4. de Groot's Distributed Feature Model (DFM). Showing overlapping features between concrete and abstract word types (Tokowicz, 2000)

Experimental Stimuli and Materials

XX. Please rate your personal experiences in communicating about health-care including when you have visited and/or accompanied relatives and/or friends to the hospital by using the following rating scheme and circling the appropriate number in the boxes below:

1 = no experience at all **2** = very little **3** = moderate **4** = very much **5** = extensive experience

Language	Communicating with Nurses / Doctors in general	Discussing, describing or inquiring about someone's pain and illness	Listening to others talk about pain and illness
English	**1 2 3 4 5**	**1 2 3 4 5**	**1 2 3 4 5**
French	**1 2 3 4 5**	**1 2 3 4 5**	**1 2 3 4 5**

Figure 5. Addendum to the Language Background Questionnaire (LBQ) on experiences either directly or vicariously with health-care communications.

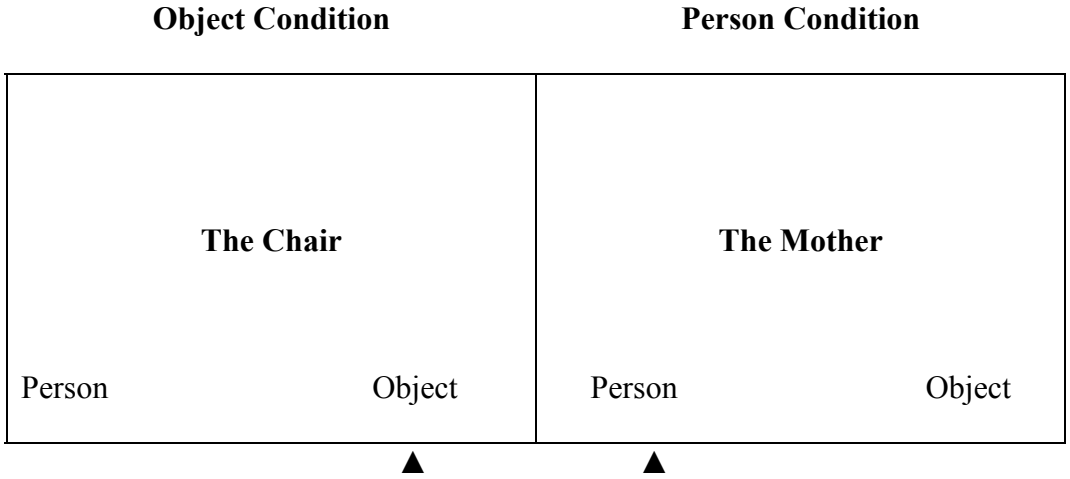

Figure 6. An example of the implementation (and correct responses) of the Person/Object general word recognition task. Words were presented sequentially and participants had to respond with either a left or right hand button-press to classify whether the word is a Person or and Object. Correct responses were recorded along with their reaction time. This task was done in both French and English.

“ a **burning** pain ” 1 - 2 - 3 - 4 - 5 - 6 - 7 **Cold** **Hot**	“ a **burning** pain ” 1 - 2 - 3 - 4 - 5 - 6 - 7 **Weak** **Strong**

Figure 7. An example of the semantic differential task. Each stimuli word was presented repeatedly with sequentially presented different pairs of polar-opposite semantic differential words rated by participants on a 7-point Likert-style scale. Words were presented in both French and English.

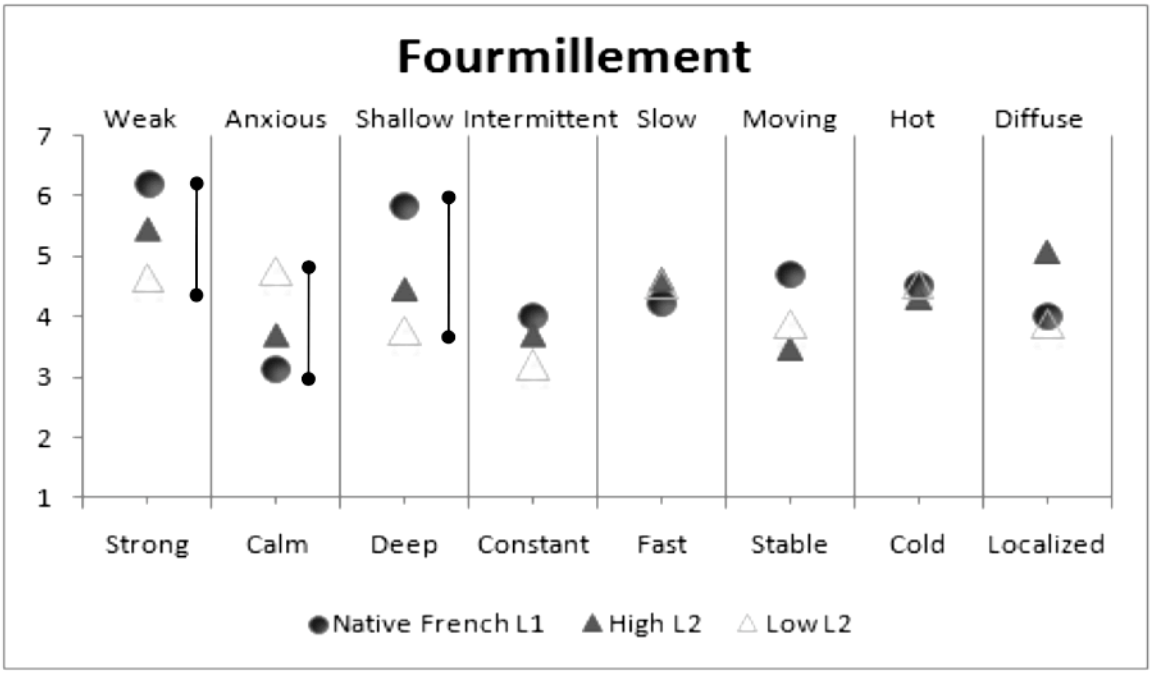

Figure 8. French word *'Fourmillement'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding.

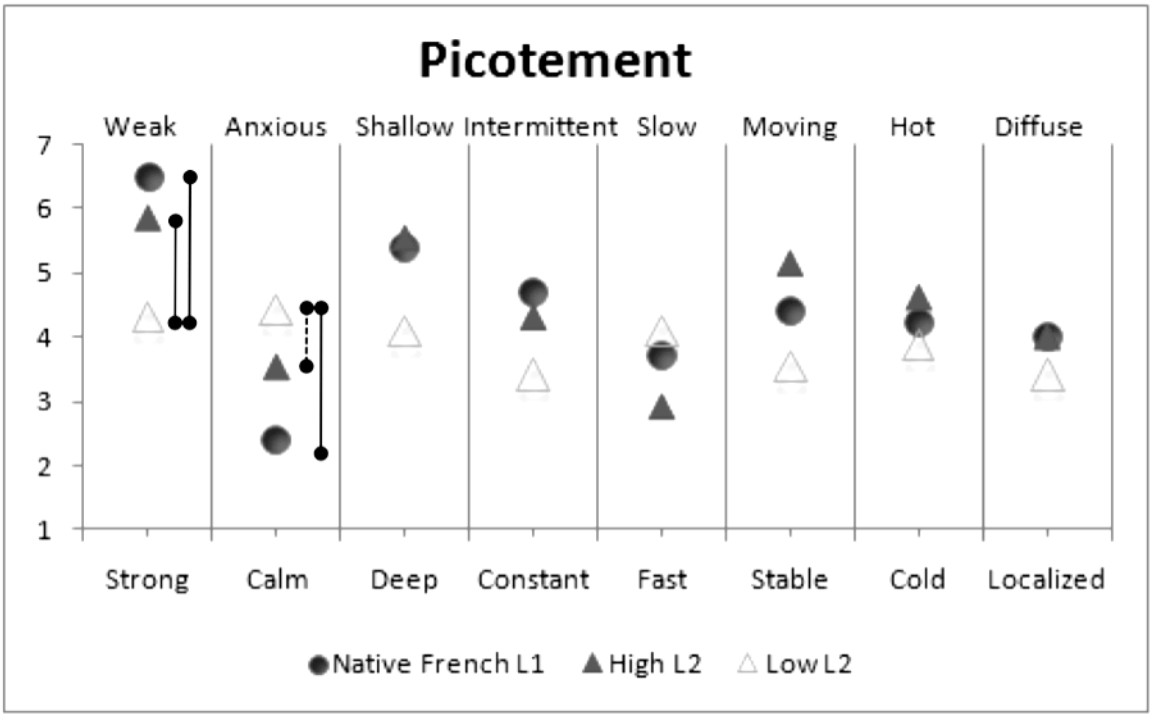

Figure 9. French word *'Picotement'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding.

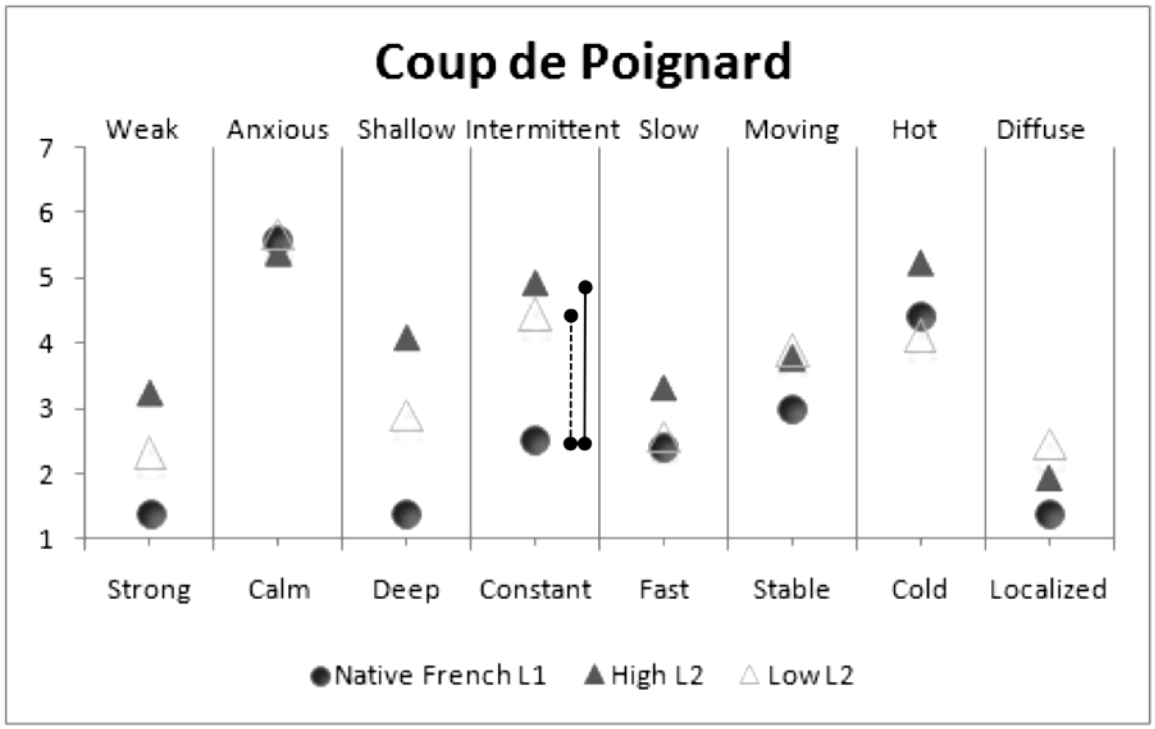

Figure 10. French phrase *'Coup de Poignard'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding.

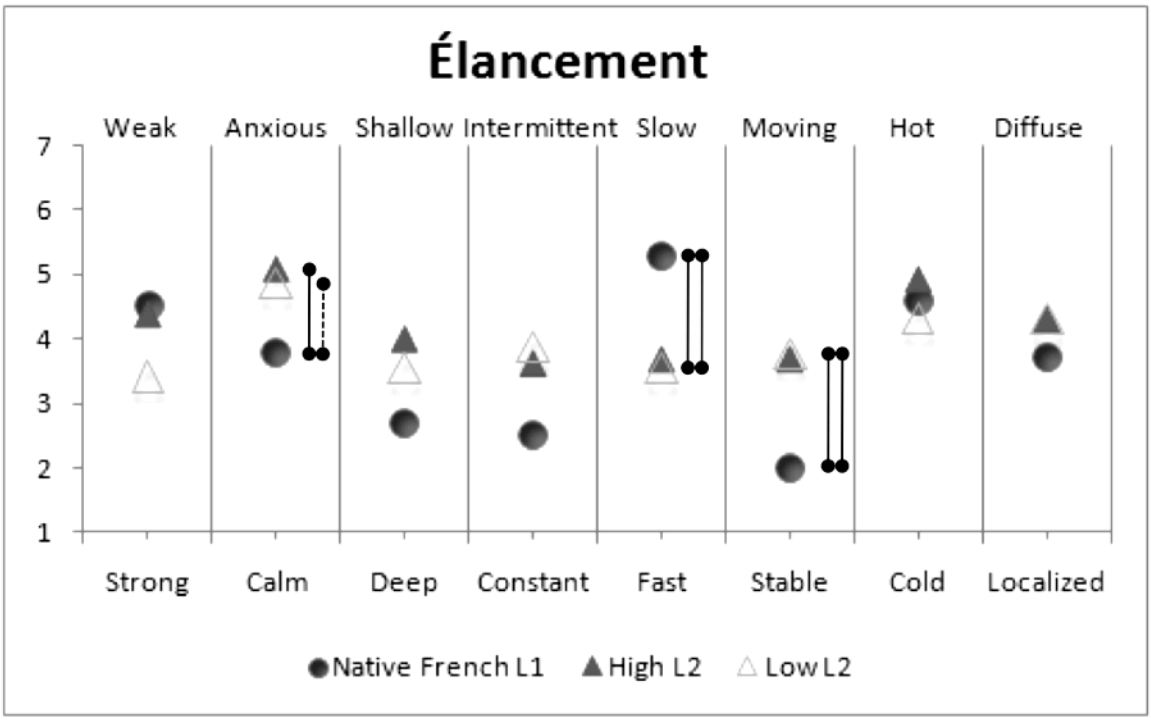

Figure 11. French word *'Élancement'* semantic-differential "dimension" ratings by proficiency. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding. In this case, there was no "improvement" between the low proficiency L2 and the high proficiency L2 compared to Native speakers on the three dimensions nonmatched by the low proficiency L2 group.

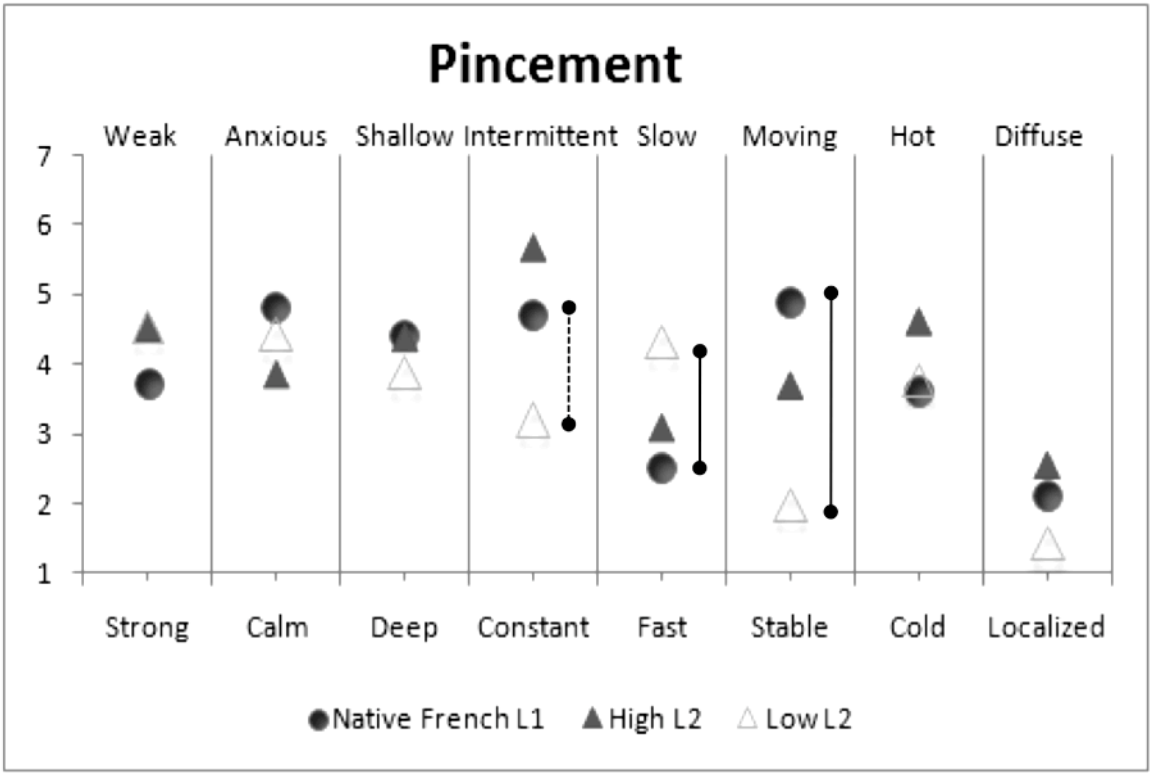

Figure 12. French word *'Pincement'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding.

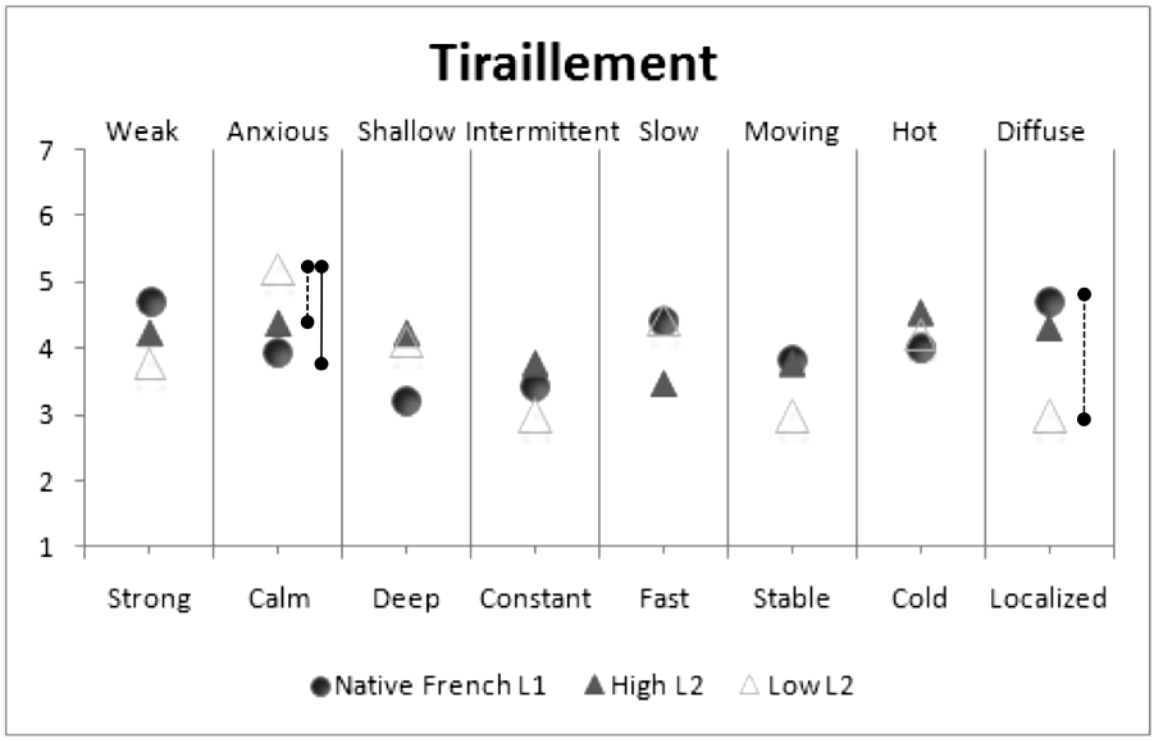

Figure 13. French word *'Tiraillement'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding.

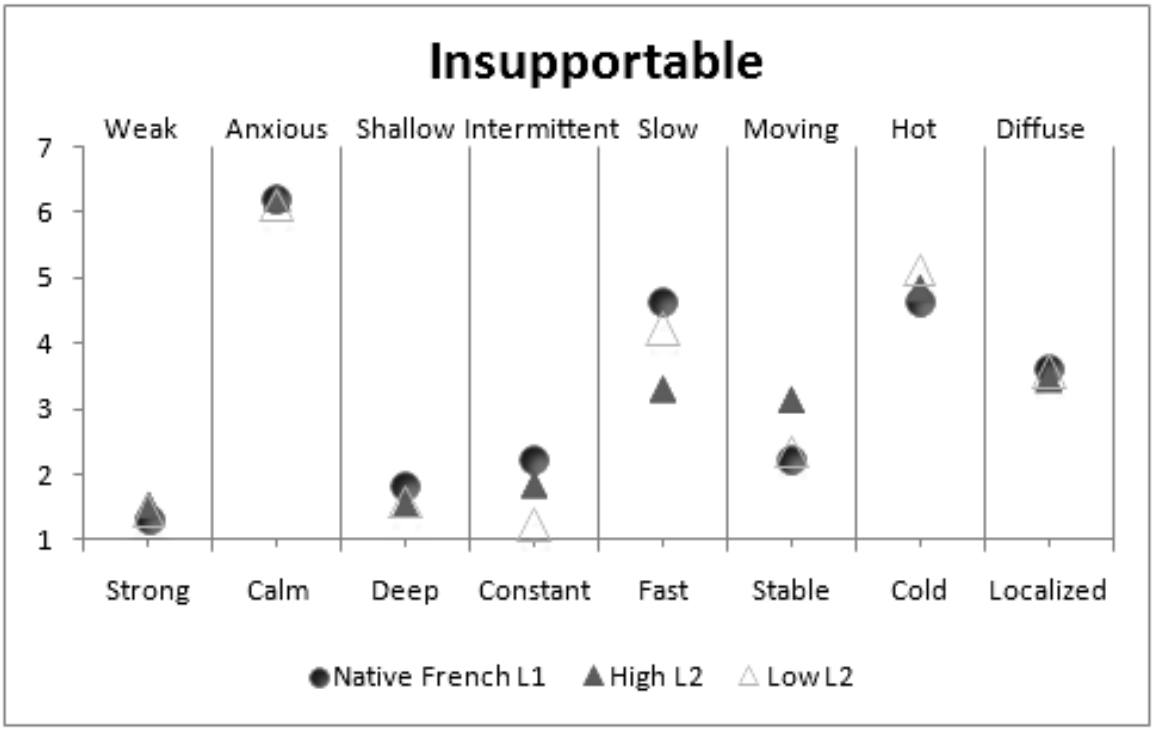

Figure 14. French word *'Insupportable'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding. In this case, no nonmatchings for any of the L2 groups indicates that this is an easy to understand pain-descriptor word for English speakers.

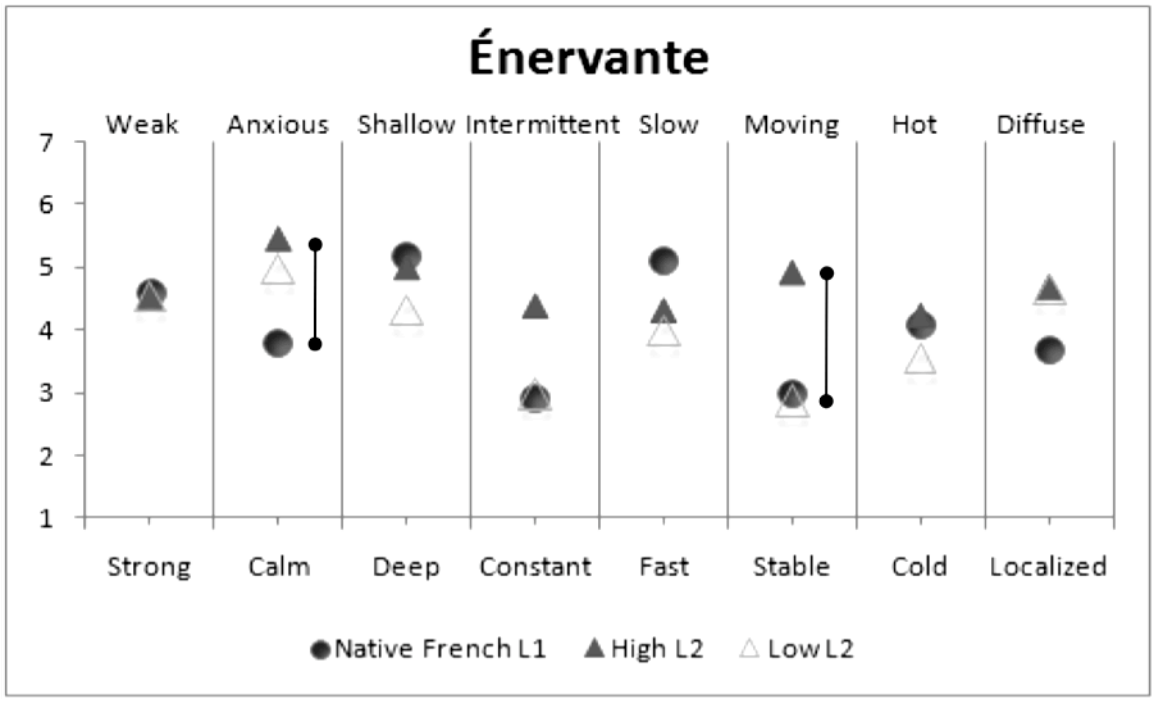

Figure 15. French word *'Énervante'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding.

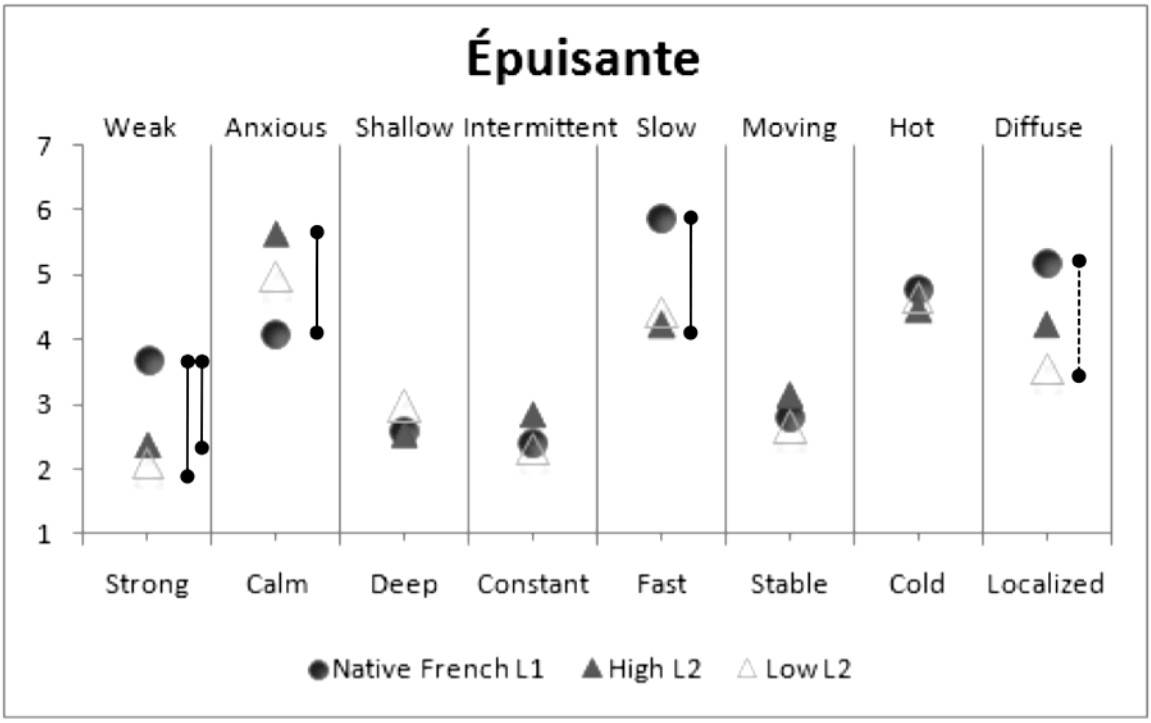

Figure 16. French word *'Épuisante'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding.

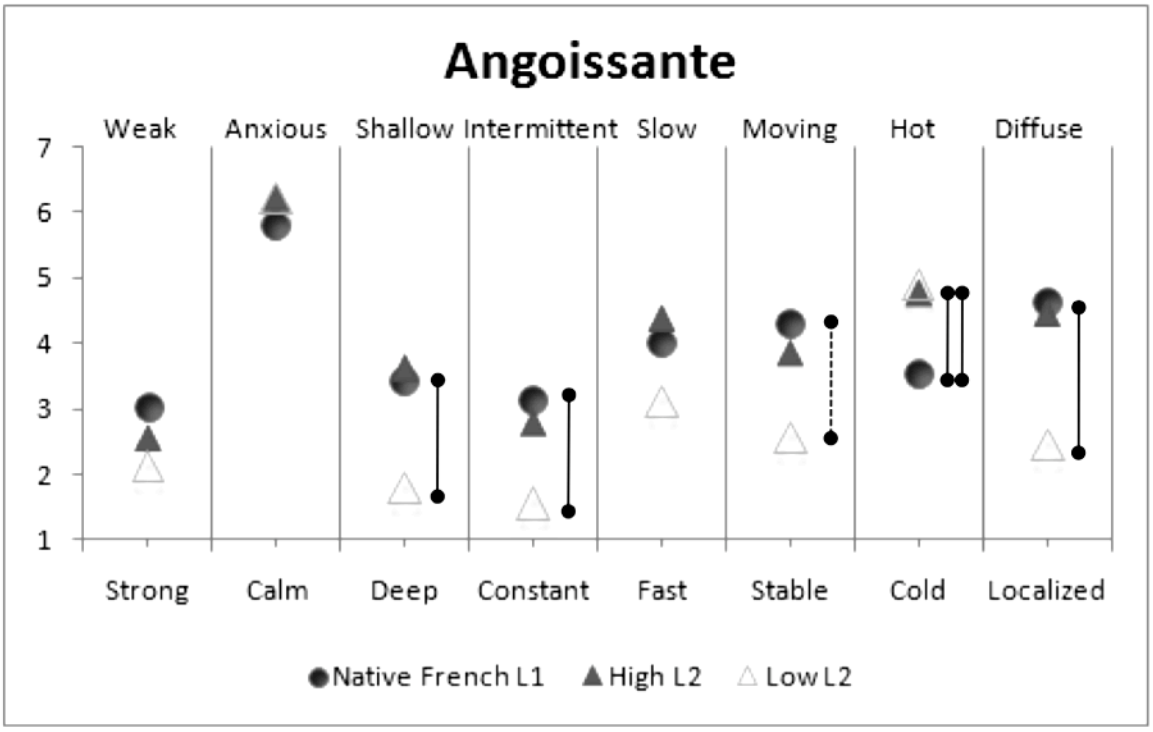

Figure 17. French word *'Angoissante'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding. With five nonmatching dimensions for the low proficiency L2 groups and four for the high proficiency L2 group, this pain-descriptor word was the most "misunderstood" for native English speakers of all the stimuli used.

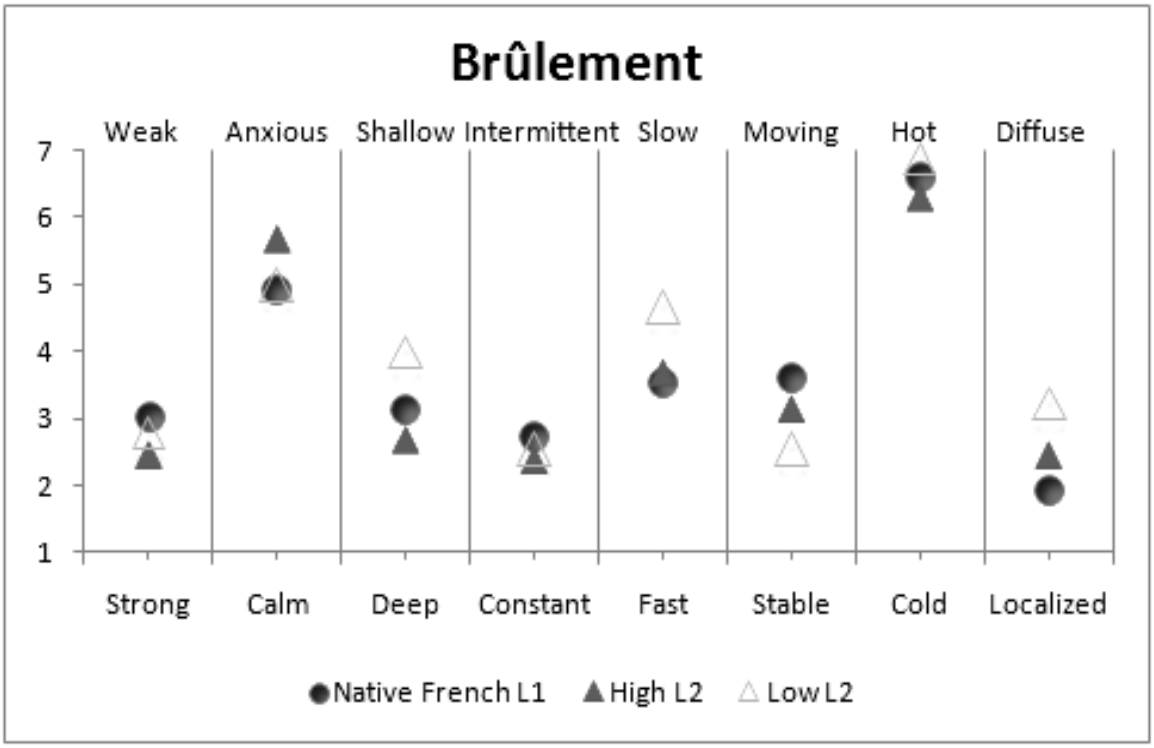

Figure 18. French word *'Brûlement'* semantic-differential "dimension" ratings by proficiency level. Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings given by L2 speakers when compared to Native L1 speakers indicates "nonmatching" of the dimension, and implies possible misunderstanding. In this case, no nonmatchings for any of the L2 groups indicates that this is an easy to understand pain-descriptor word for English speakers.

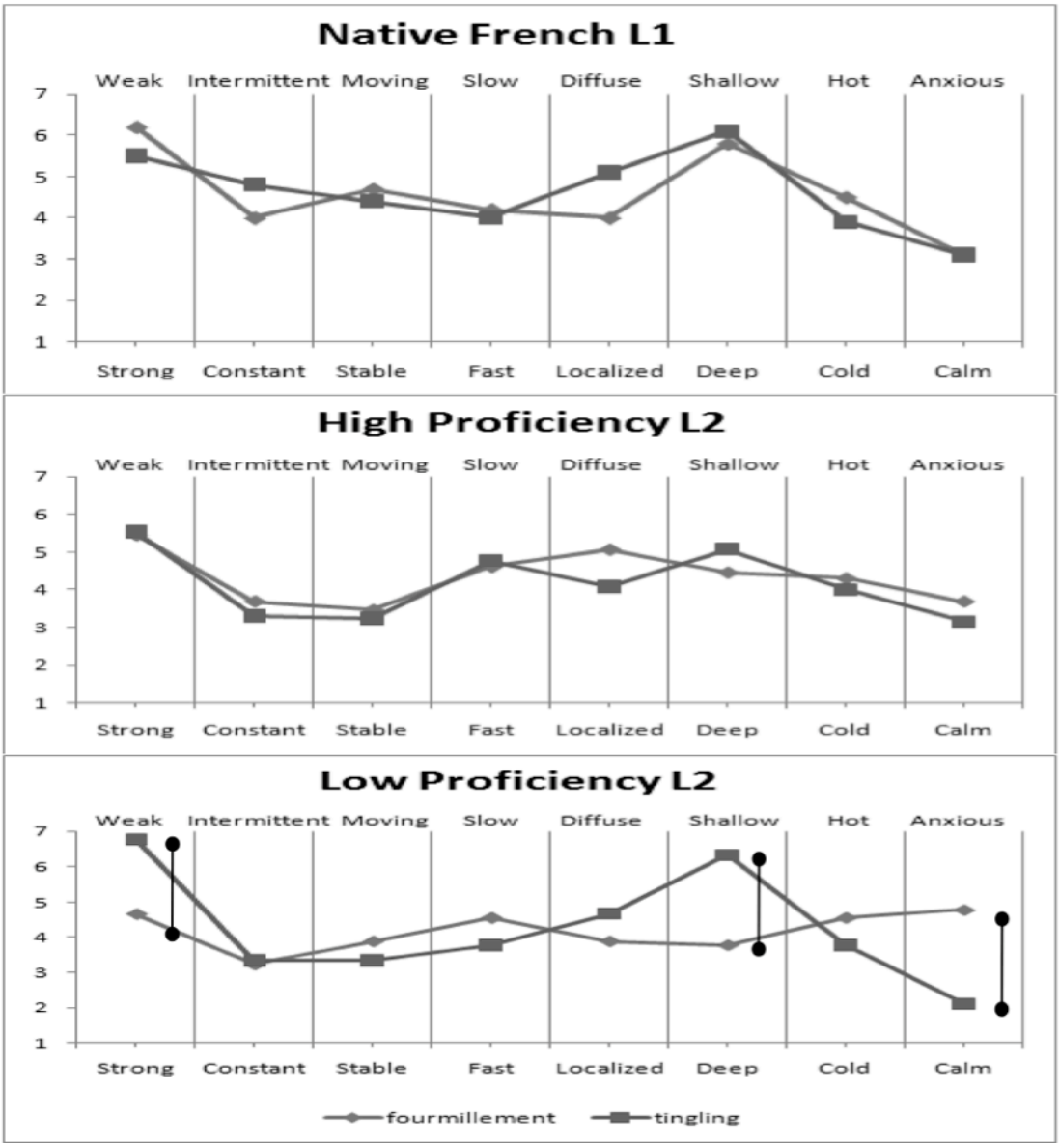

Figure 19. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French word *'Fourmillement'* with the English word 'Tingling.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. In this case the low proficiency L2 group believes there are differences on three dimensions, where the native speakers and high proficiency L2 group agree on the exact translation equivalence.

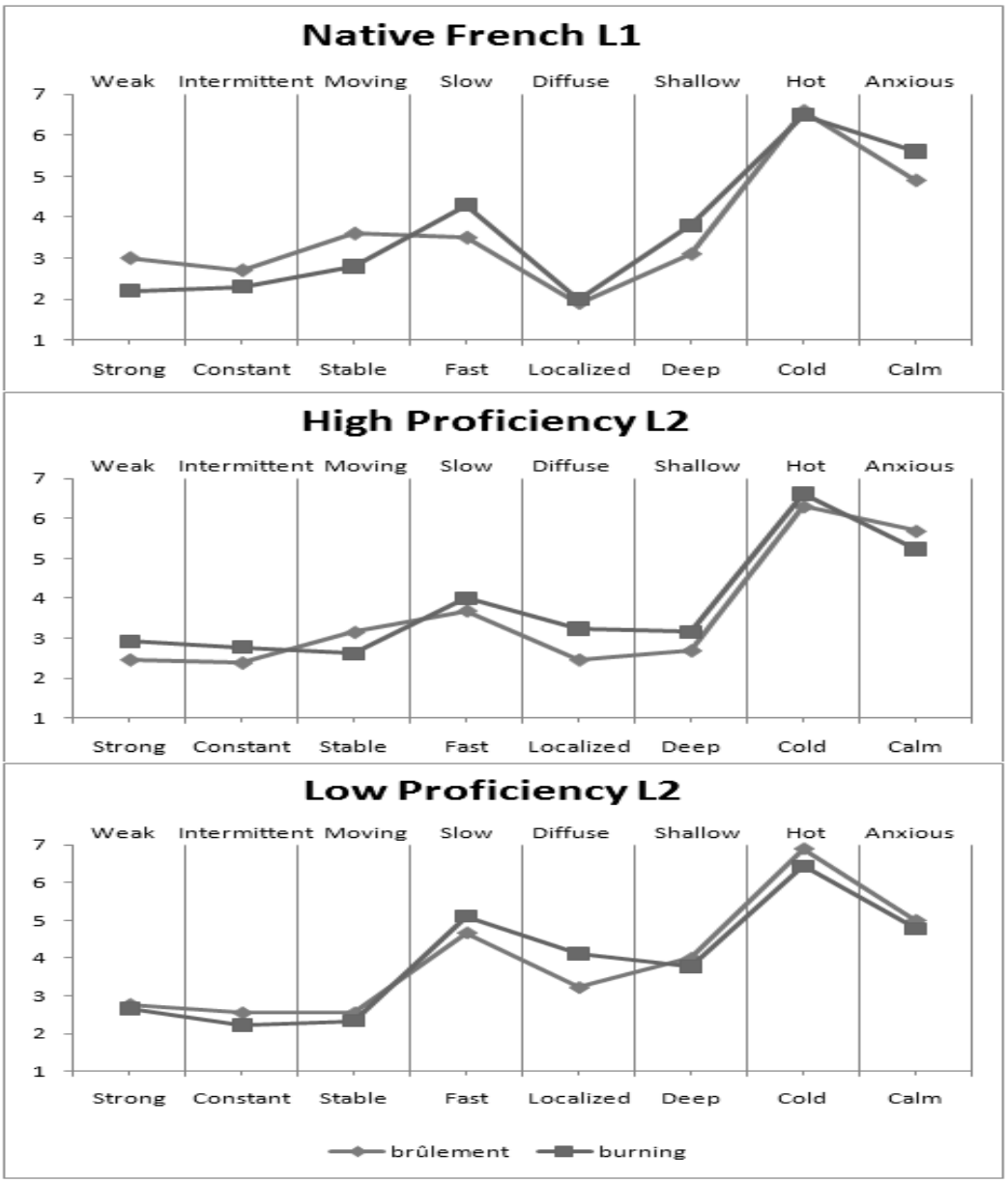

Figure 20. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French word *'Brûlement'* with the English word 'Burning.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. All groups agree on exact translation equivalence here.

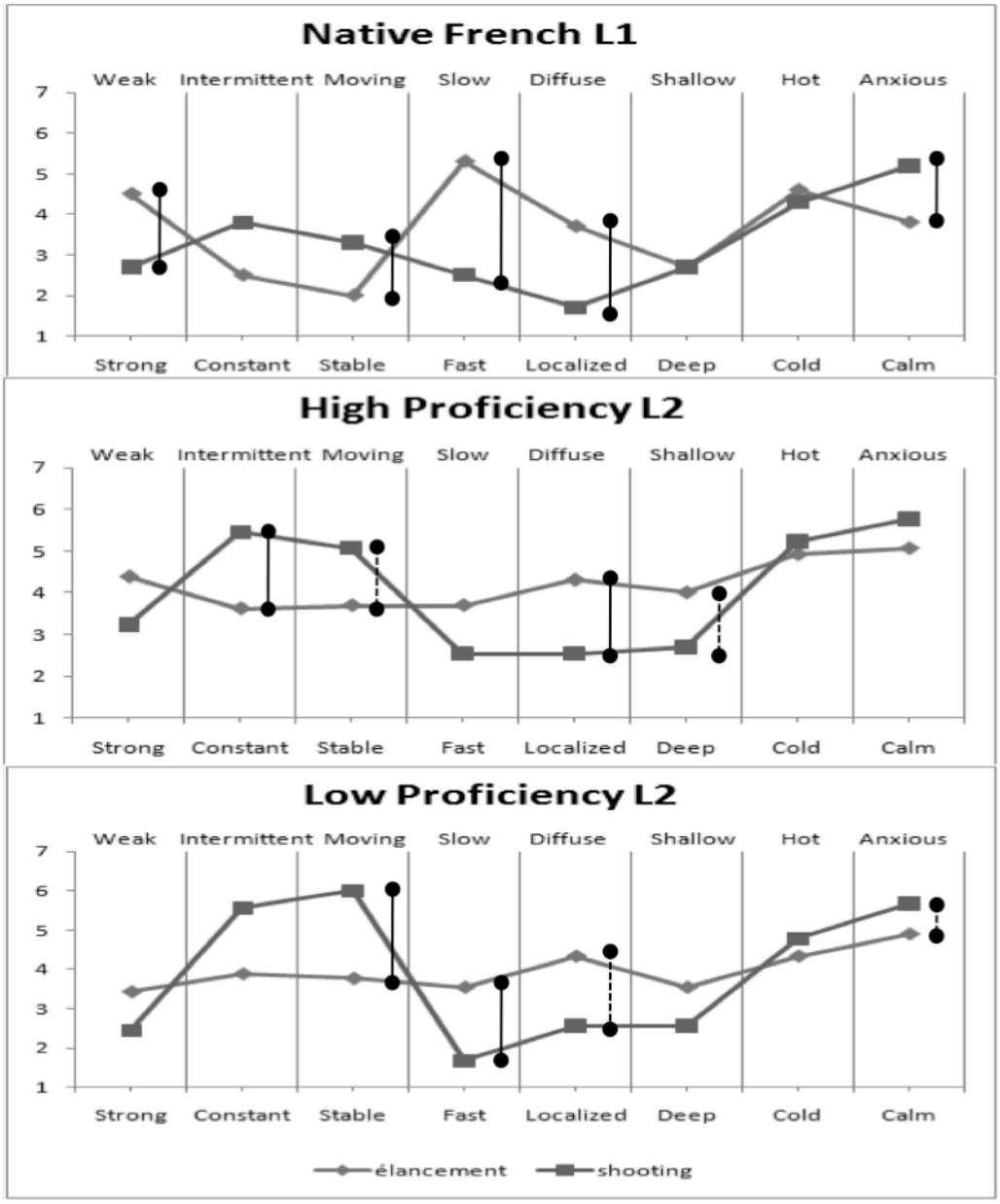

Figure 21. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French word *'Élancement'* with the English word 'Shooting.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. All groups find many differences between these two words.

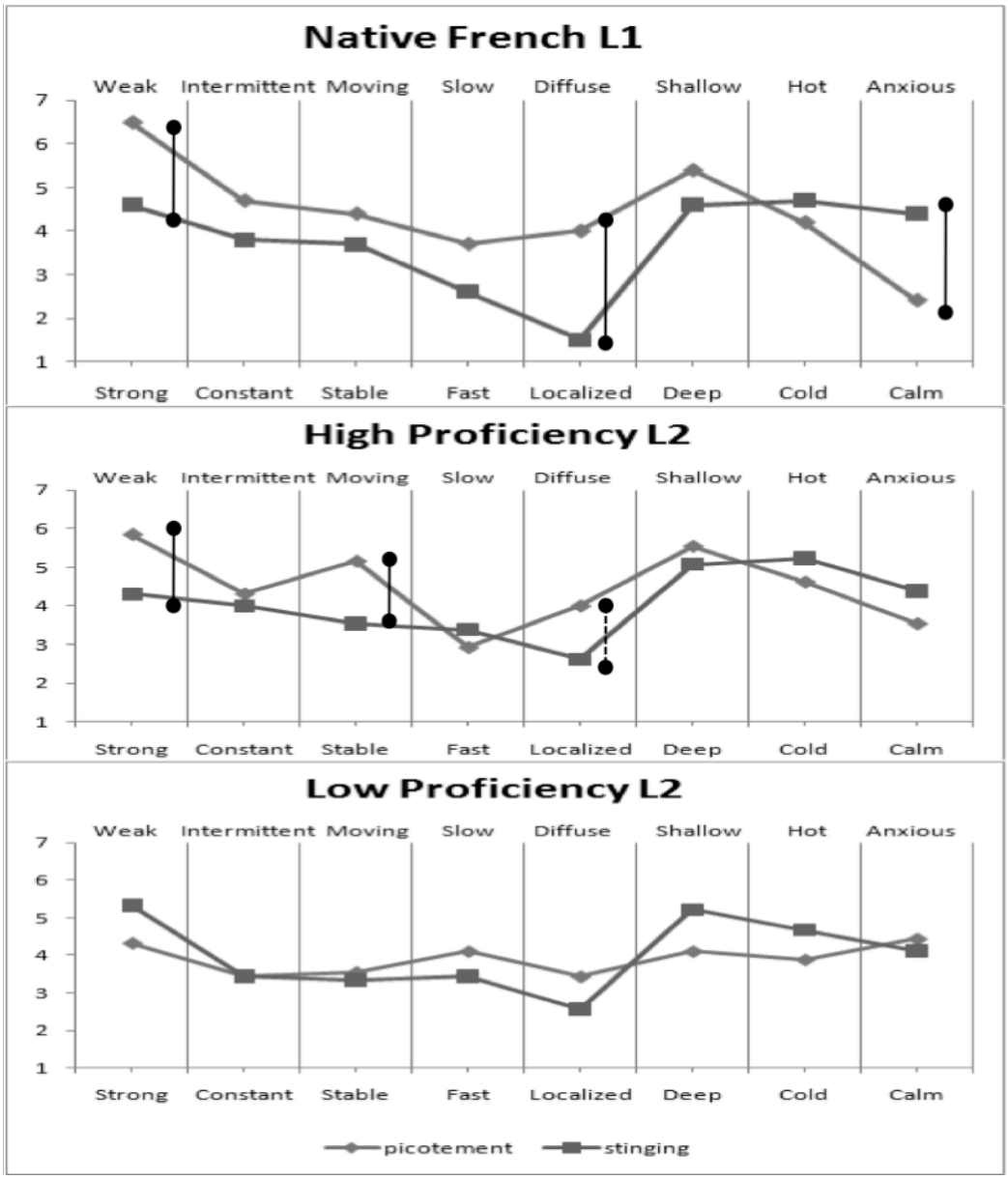

Figure 22. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French word *'Picotement'* with the English word 'Stinging.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. Here we see the low proficiency group uses lexical mediation.

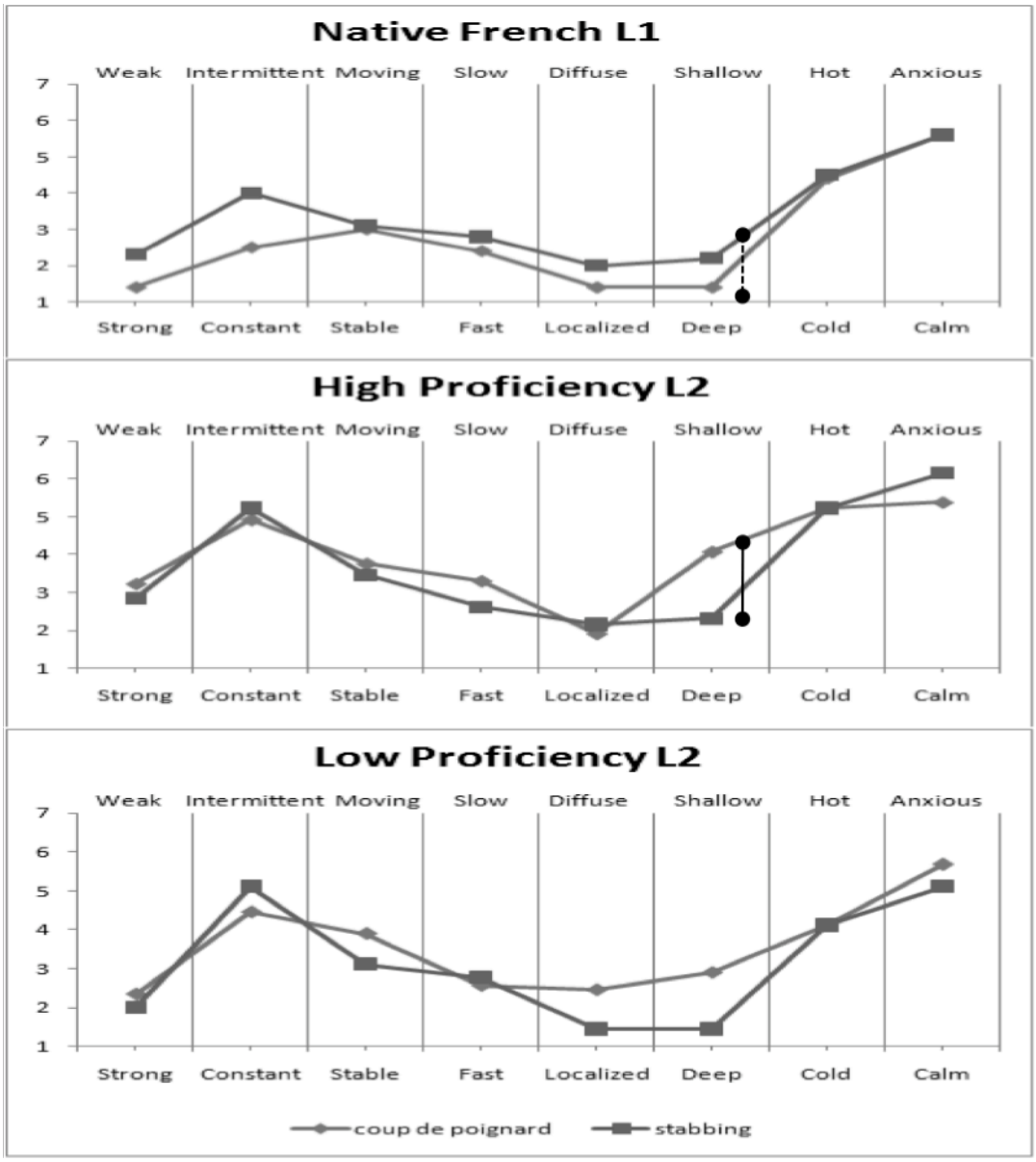

Figure 23. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French phrase *'Coup de Poignard'* with the English word 'Stabbing.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. Evidence of low proficiency lexical mediation.

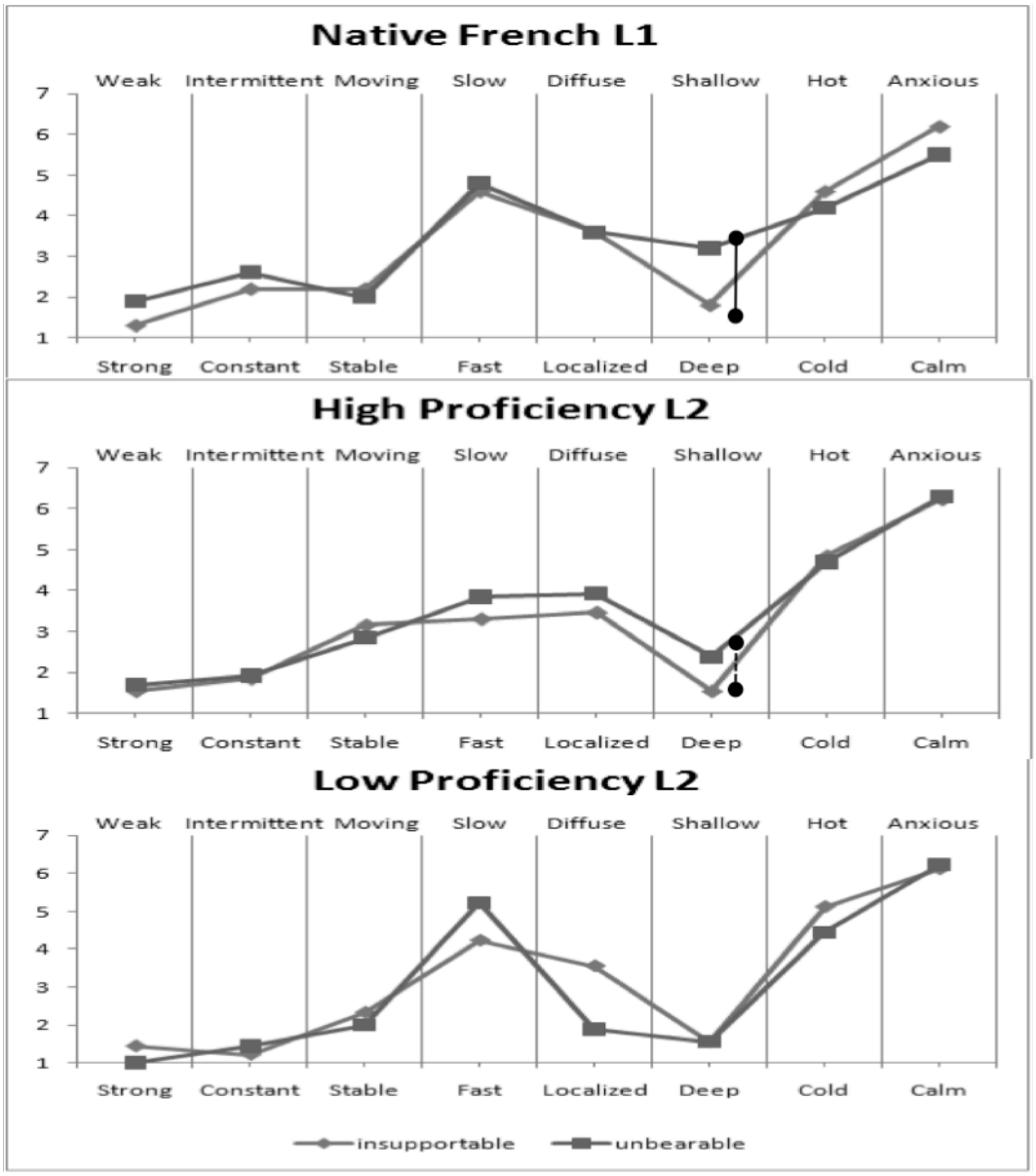

Figure 24. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French word *'Insupportable'* with the English word 'Unbearable.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. Evidence of low proficiency lexical mediation.

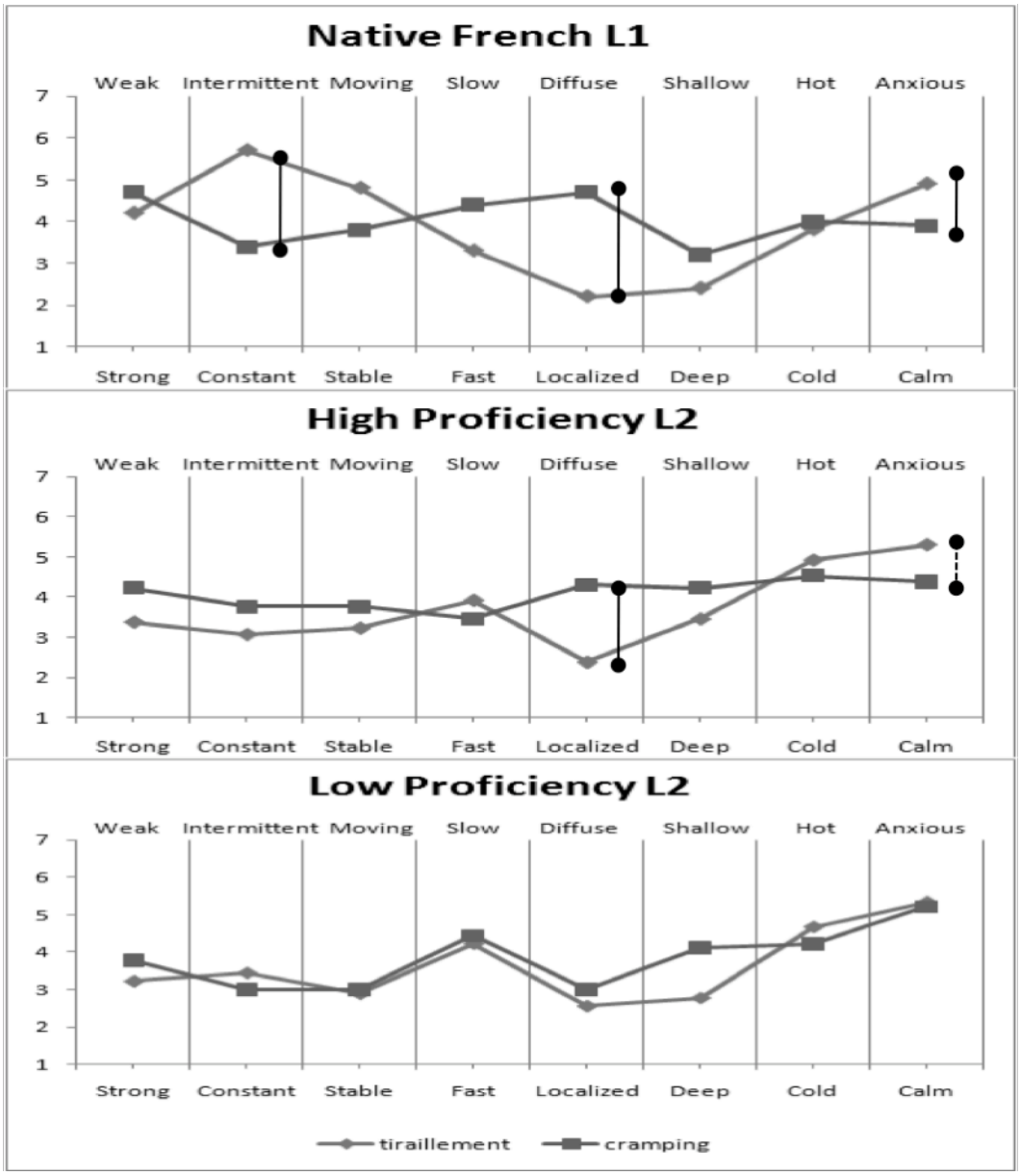

Figure 25. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French word *'Tiraillement'* with the English word 'Cramping.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. Evidence of low proficiency lexical mediation.

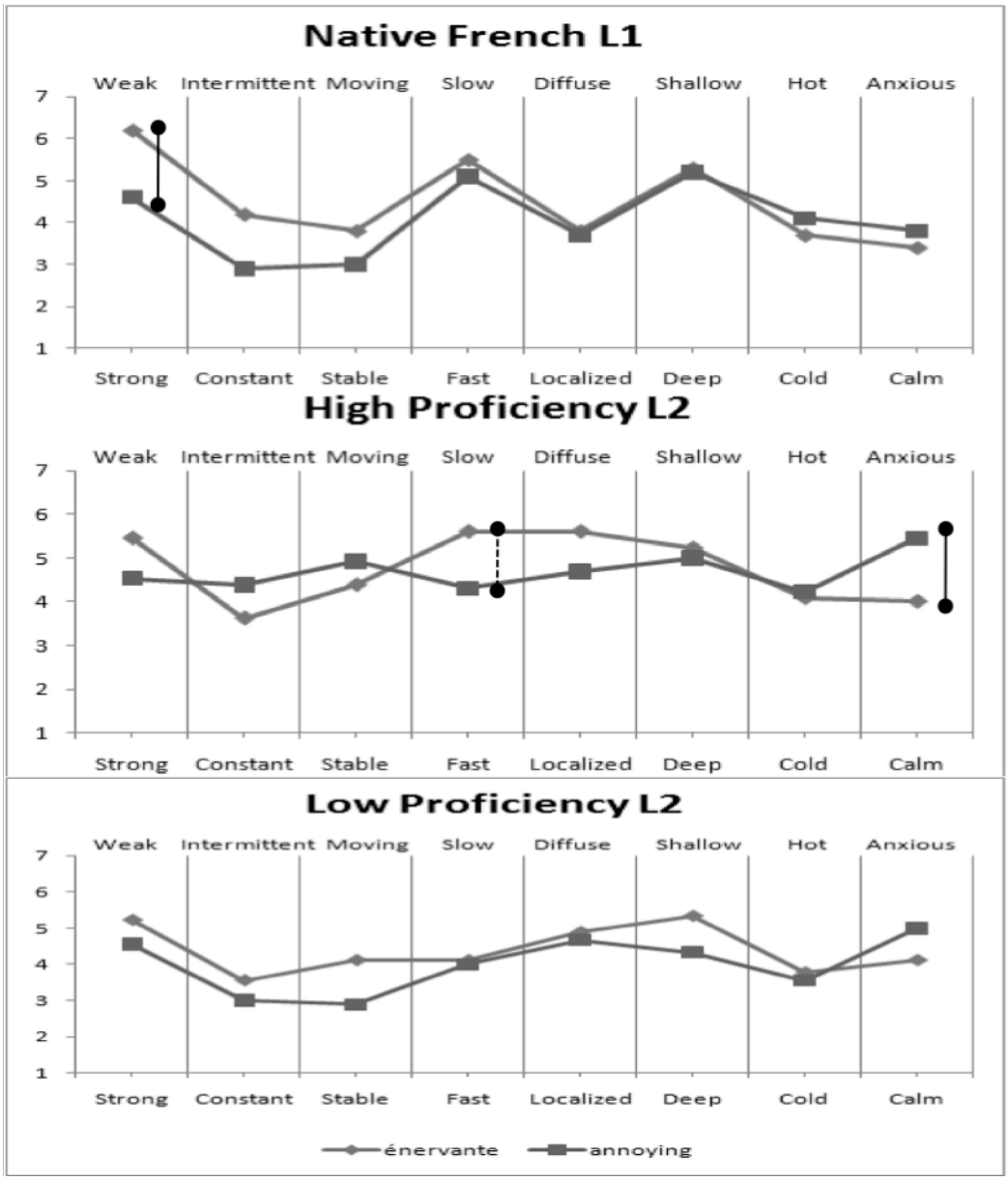

Figure 26. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French word *'Énervante'* with the English word 'Annoying.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. Evidence of low proficiency lexical mediation, with recognition of difference (whilst incorrect) by the high proficiency group.

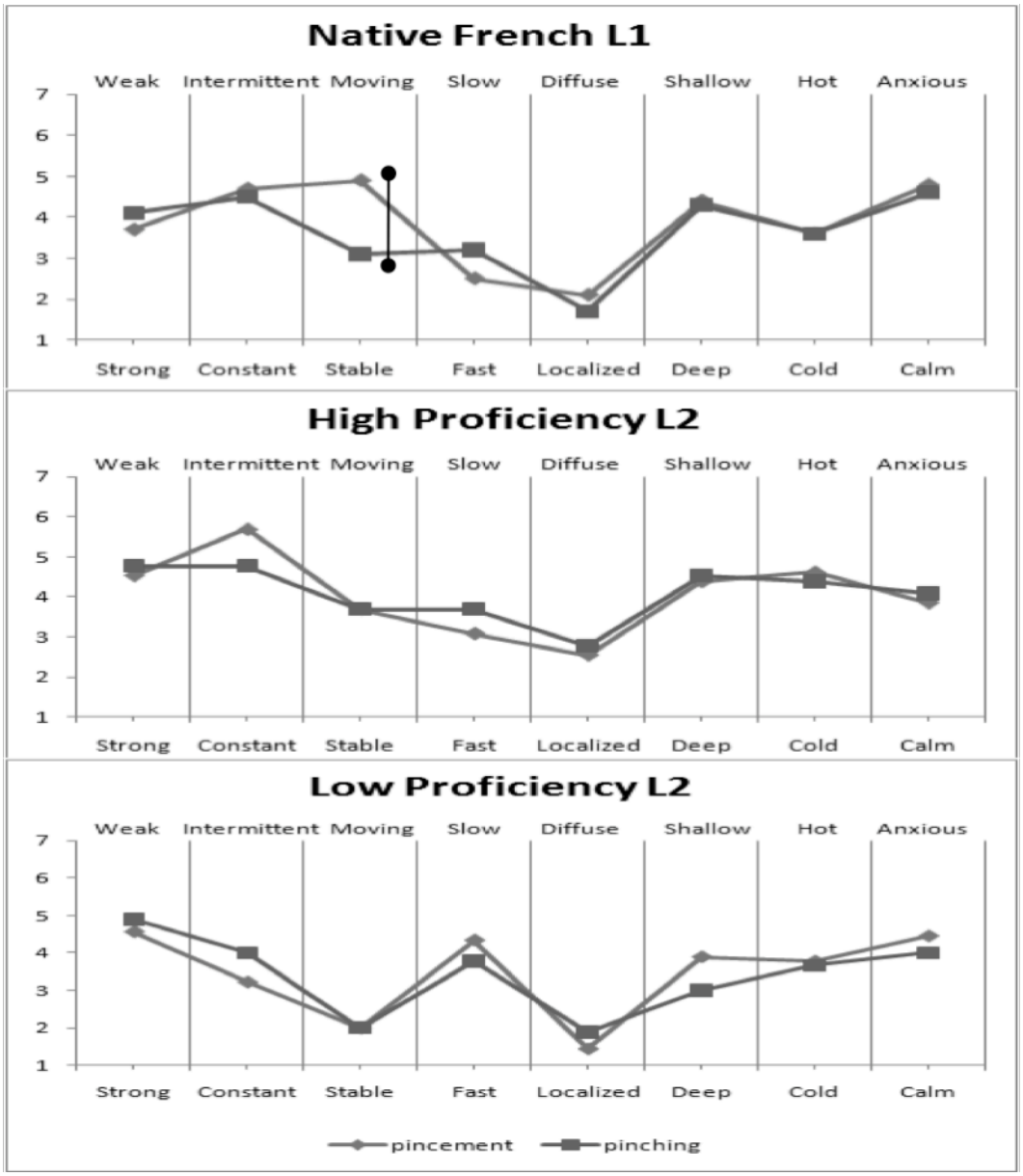

Figure 27. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French word *'Pincement'* with the English word 'Pinching.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. Evidence for high and low proficiency lexical mediation.

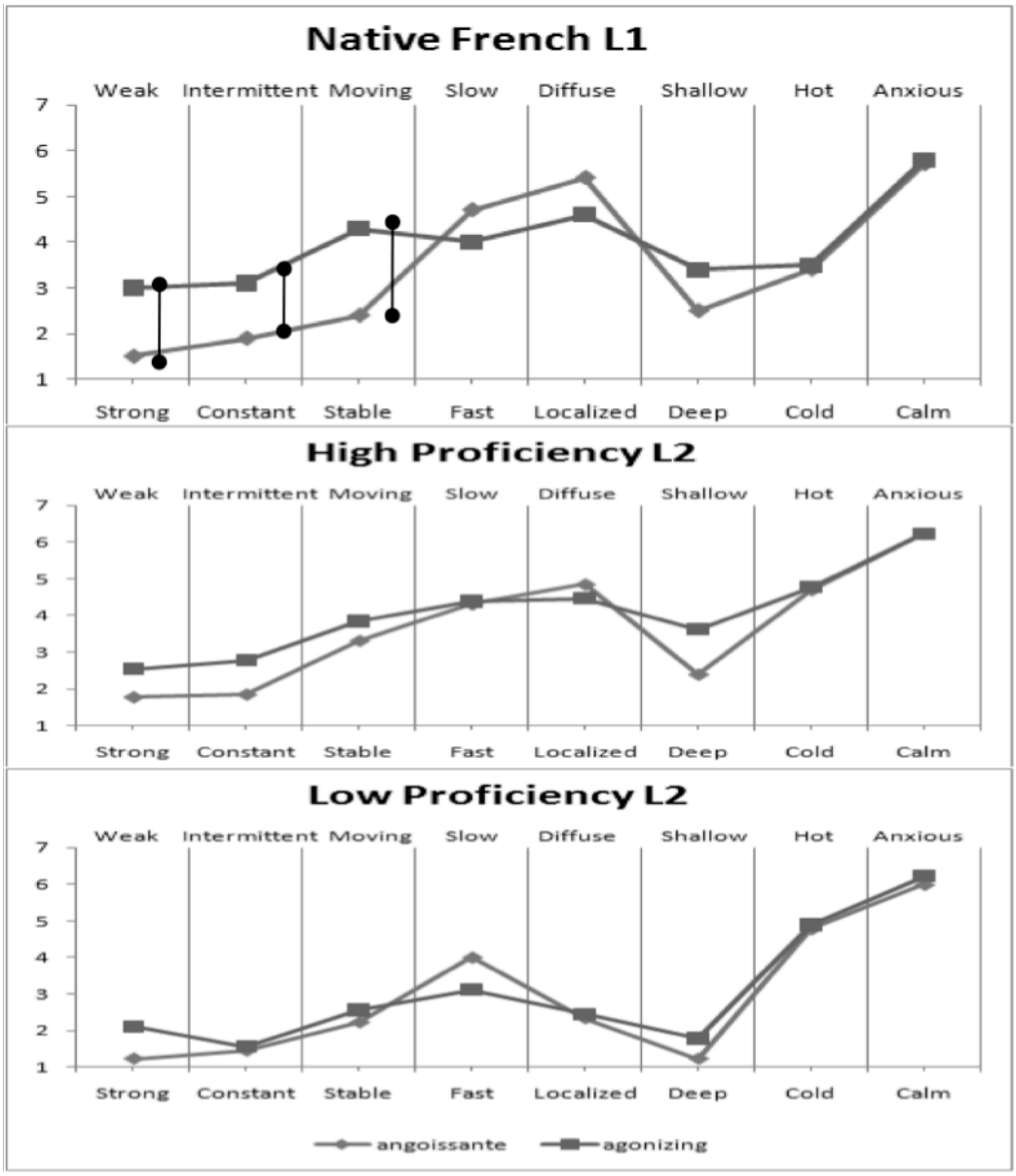

Figure 28. Comparison of semantic-differential "dimension" ratings by proficiency level and compared with the close-translation equivalent stimuli word in the other language. In this case the French word *'Angoissante'* with the English word 'Agonizing.' Significant ($p<0.05$) (solid line between markers) or near-significant ($p<0.08$) (dashed line between markers) differences between mean ratings between the close-translation equivalents indicates an acknowledgement of difference on the respective dimension between the two words across languages. Evidence for high and low proficiency lexical mediation.

Appendix

Language Background Questionnaire

LANGUAGE BACKGROUND QUESTIONNAIRE

Name : _____ Date _____

Age : _____ Sex: M ___ F___

If you are a student:

What is your field of study? _____

What degree are you pursuing? College/Cégep ___ Bachelor ___ MA/PhD ___

1. Where were you born? City:_____ Country: _____
2. What do you consider to be your **first learned language**?

   English ___ French ___ Other _____
3. What do you consider to be your **second learned language**?

   English ___ French ___ Other _____
4. At what age did you learn your **second language**? _____
5. What language do you consider your dominant language?

   English ___ French ___ Other _____
6. What language do you speak at home now? _____
7. What is the first language of your: Mother? _____ Father? _____
8. In what language did you attend school? (Please check the appropriate one):

   - Elementary school: English ___ French ___ French Immersion ___ Other _____
   - Middle/High school: English ___ French ___ French Immersion ___ Other _____
   - College/Cégep: English ___ French ___ Other _____
   - University: English ___ French ___ Other _____

9. If you are not currently a student, what is the highest level of education you have completed:

   High school ___ College ___ University (Bachelor) ___ University (MA/PhD) ___

10. Have you received second language instruction in school at any of the levels listed below, and for how long?
YES ___ NO ____

If YES, specify each language, starting with your main second language.

MAIN SECOND LANGUAGE: _____

- Elementary School: less than 1 year ___ 1-2 years ___ more than 2 years ___
- Middle/High School: less than 1 year ___ 1-2 years ___ more than 2 years ___
- College/Cégep/University: less than 1 year ___ 1-2 years ___ more than 2 years ___
- Other: less than 1 year ___ 1-2 years ___ more than 2 years ___

Please specify: _____

THIRD LANGUAGE (if any): _____

- Elementary School: less than 1 year ___ 1-2 years ___ more than 2 years ___
- Middle/High School: less than 1 year ___ 1-2 years ___ more than 2 years ___
- College/Cégep/University: less than 1 year ___ 1-2 years ___ more than 2 years ___
- Other: less than 1 year ___ 1-2 years ___ more than 2 years ___

Please specify: _____

Any other special school-related learning experiences (e.g., intensive French in Grade 6):

_____

11. Do you have any visual impairment NOT corrected by wearing glasses or contact lenses? Yes ___ No ___

12. Do you have any known hearing impairment? Yes ___ No ___

13. Do you have a known reading or attention disability? Yes ___ No ___

14. Please rate your level of ability for each of the four skills listed below by using the following rating scheme and circling the appropriate number in the boxes below:

1 = no ability at all **2** = very little **3** = moderate **4** = very good **5** = fluent ability

Language	Speaking	Reading	Writing	Listening
English	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
French	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Other _____	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5

15. Have you lived in a region where you used a language other than your first language for an extended period of time? (Add periods of time together if necessary, e.g., for two visits to France of 6 months and 3 months duration you would put "French, France, 9 months")

Language: FRENCH Region: _____ Duration: _____

Language: _____ Region: _____ Duration: _____

Language: _____ Region: _____ Duration: _____

The following questions ask you about your use of **ENGLISH** in various situations. Please think about your experiences during the past two months when answering these questions. *Do not include activities that occur in the context of language instruction or language classes if you are presently studying English as a second language*. Please ***circle*** *two* answers for every question to indicate (a) the number of days per week and (b) the amount of time per day spent:

16. Speaking in ENGLISH to native or fluent speakers of English:

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?		less than 10 minutes	10 minutes to 1 hour		more than 1 hour but less than 2		2 hours or more

17. Listening to ENGLISH (at meetings, to lectures, radio, television, movies, videos, songs, etc.):

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?		less than 10 minutes	10 minutes to 1 hour		more than 1 hour but less than 2		2 hours or more

18. Reading ENGLISH when surfing the Web:

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?		less than 10 minutes	10 minutes to 1 hour		more than 1 hour but less than 2		2 hours or more

19. Reading ENGLISH (magazines, newspapers, books, etc.):

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?		less than 10 minutes	10 minutes to 1 hour		more than 1 hour but less than 2		2 hours or more

20. Writing in ENGLISH (e-mails, personal notes, letters, etc):

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?		less than 10 minutes	10 minutes to 1 hour		more than 1 hour but less than 2		2 hours or more

The following questions ask you about your use of **FRENCH** in various situations. Please think about your experiences during the past two months when answering these questions. *Do not include activities that occur in the context of a language instruction or language classes if you are presently studying French as a second language*. Please ***circle*** *two* answers for every question to indicate (a) the number of days per week and (b) the amount of time per day spent:.

21. Speaking in FRENCH to native or fluent speakers of French:

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?	less than 10 minutes	10 minutes to 1 hour	more than 1 hour but less than 2	2 hours or more			

22. Listening to FRENCH (at meetings, to lectures, radio, television, movies, videos, songs, etc.):

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?	less than 10 minutes	10 minutes to 1 hour	more than 1 hour but less than 2	2 hours or more			

23. Reading FRENCH when surfing the Web:

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?	less than 10 minutes	10 minutes to 1 hour	more than 1 hour but less than 2	2 hours or more			

24. Reading FRENCH (magazines, newspapers, books, etc.):

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?	less than 10 minutes	10 minutes to 1 hour	more than 1 hour but less than 2	2 hours or more			

25. Writing in FRENCH (e-mails, personal notes, letters, etc):

Typically, how many days per week: 0	1	2	3	4	5	6	7
On those days, typically how much time?	less than 10 minutes	10 minutes to 1 hour	more than 1 hour but less than 2	2 hours or more			

26. Some people feel very close to or identify with the community that normally speaks their second language. Indicate below how close you feel to English and French speakers in general. Circle the appropriate number (1 = you feel much closer to English-speakers; 5 = you feel equally close to English and French speakers; 9 = you feel much closer to French-speakers).

1	2	3	4	5	6	7	8	9
feel much closer to English speakers				feel about equally close to English and French speakers				feel much closer to French speakers

27. Some people, when speaking their second language, have very little or no accent at all. Other people, when speaking their second language, have a very strong accent. Compare how much accent you have, when speaking normally, in English compared to French. Circle the appropriate number (1 = much more accent in English; 5 = equally good accents in the two languages; 9 = much more accent in French).

1	2	3	4	5	6	7	8	9
much more accent in English				about the same amount of accent				much more accent in French

28. Imagine that you had to speak quickly in order to complete an important message in a very short time. Compare how fast you can speak in English compared to French under such conditions. Circle the appropriate number (1 = much faster in English; 5 = equally fast in the two languages; 9 = much faster in French).

1	2	3	4	5	6	7	8	9
much faster in English				about the same				much faster in French

29. Some people normally speak in a very fluent or smooth way, with very few hesitations or interruptions in their speech. Other people normally speak in a much less fluent way, with many hesitations or interruptions in their speech. Compare how smoothly you can speak in English compared to French when speaking normally. Circle the appropriate number (1 = much more smoothly in English; 5 = equally smoothly in the two languages; 9 = much more smoothly in French).

1	2	3	4	5	6	7	8	9
much smoother in English				about the same				much smoother in French

30. Some people normally have very little difficulty finding the words they want to use, when speaking normally. Other people normally have much more difficulty finding the words they want to use, when speaking normally. Compare how easy it is for you to find the words you want to use, when speaking normally, in English compared to French. Circle the appropriate number (1 = much easier in English; 5 = equally easy in the two languages; 9 = much easier in French).

1	2	3	4	5	6	7	8	9
much easier in English				about the same				much easier in French