LA ORGANIZACIÓN DE LA MEMORIA BILINGÜE: CONEXIONES LÉXICAS Y CONCEPTUALES EN LA ADQUISICIÓN DE LA SEGUNDA LENGUA

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Índice de contenidos

Presentación

Cuando se habla de la importancia del estudio del bilingüismo se suele poner como ejemplo un recuento de lenguas y países: existen alrededor de 6000 lenguas en nuestro planeta (Crystal, 1987) y un número cercano a 200 países (lo que supondría una media de 30 lenguas por país). Sin embargo, que se hablen muchas lenguas en una misma zona no asegura que las personas sean necesariamente bilingües. Para que se dé el caso es necesario que las lenguas entren en contacto, y que las lenguas entren en contacto significa, ni más ni menos, que entren en contacto las personas que las usan (Wei, 2000).

Los motivos por los cuales una persona puede convertirse en bilingüe son muy variados y no siempre responden a procesos voluntarios. Existen causas políticas, culturales, económicas o de carácter personal. Todo ello hace que el bilingüismo sea un fenómeno que despierta interés en áreas de conocimiento tan diversas como la historia, la sociología, la pedagogía, la filología o, por supuesto, la psicología. Dentro de esta última también se enfoca su estudio de manera distinta según el área. Así, el bilingüismo ha sido objeto de investigación dentro de la psicología social, la psicología evolutiva o, por ejemplo, la psicología diferencial. En los últimos años ha habido un interés creciente en el estudio de este fenómeno tanto dentro de la psicolingüística como de la neurociencia. El presente trabajo se enmarca precisamente dentro de la psicolingüística y se centra en el estudio de los procesos de comprensión escrita del lenguaje en el nivel de las palabras (procesos léxicos), en hablantes bilingües de castellano y de catalán.

Cuando a cualquiera de nosotros (presumiblemente ignorantes todos del idioma mongol) se nos presenta por primera vez la palabra *nokhoi*, creamos una representación léxica huérfana de significado. Posteriormente, nos comentan que *nokhoi* se refiere a lo mismo a lo que se refiere nuestra palabra ‘perro’, de manera que automáticamente *nokhoi* cobraría un sentido heredado de nuestra bien conocida palabra ‘perro’. Llegados a este punto, diríamos que las representaciones léxicas de ambas palabras (su forma) están conectadas entre sí y comparten

una representación semántica/conceptual común. Sin embargo, ¿podemos decir realmente que cuando vemos u oímos la palabra *nokhoi* accedemos a esa representación común como lo hacemos cuando la palabra está en nuestra primera lengua (L1)? Es posible, por ejemplo, que cuando no hemos adquirido competencia en la segunda lengua (L2) y no tenemos experiencia con las palabras de esta lengua, tengamos que apoyarnos en la palabra equivalente en la L1 (i. e.: la traducción). También podría ser que la nueva palabra en la segunda lengua no nos permita acceder a toda la información de la representación semántica/conceptual correspondiente (i. e.: todos los sentidos y usos de su significado). Por lo tanto, adquirir una nueva palabra en la L2 no es sólo 'conocer' cuál es la forma de la palabra equivalente en la L1, sino también establecer una correspondencia con la representación semántica/conceptual existente que permita un acceso directo y pleno al significado. Centrándonos en el reconocimiento visual de palabras, el objetivo general de esta tesis es estudiar este proceso de adquisición de palabras en la L2, qué cambios ocurren en dicho proceso según aumenta la competencia en esta lengua, qué variables pueden afectar a dicho proceso o cuáles son las condiciones que lo facilitan. Si podemos contribuir a conocer en mayor medida la respuesta a estas preguntas, estaremos más cerca de entender cómo se adquiere el vocabulario de una segunda lengua.

En los capítulos que se desarrollan a continuación se abordará el objetivo general que se acaba de exponer. En el primer capítulo concretaremos el problema a estudiar, estableceremos el marco teórico y describiremos los principales modelos de organización de la memoria bilingüe que nos acompañarán a lo largo de toda la tesis. Además, revisaremos la literatura más relevante acerca de cómo los bilingües con distintos niveles de competencia acceden al nivel semántico/conceptual desde sus dos lenguas. También expondremos los estudios que se han centrado en otras variables relacionadas con el significado y que han demostrado ser relevantes para el estudio de este nivel de representación. En particular, trataremos el tema del grado de relación semántica entre palabras en distintas lenguas. En el segundo capítulo presentaremos la parte correspondiente al trabajo experimental, recogido en cuatro artículos de investigación publicados en distintas revistas de ámbito internacional. Finalmente, en el tercer capítulo se discutirán los resultados obtenidos en los distintos experimentos en relación con el marco teórico que se describe a continuación.

I.- INTRODUCCIÓN

1.1.- La organización de la memoria bilingüe

Una pregunta clave a la que trata de dar respuesta la psicolingüística actual, es si los bilingües disponen de un sistema de representación específico para cada una de sus lenguas, o si ambas comparten el mismo sistema. Desde que dicha pregunta se formuló por primera vez en los años 50, se han producido numerosos avances. Uno de los principales es el consenso en considerar la necesidad de separar el nivel léxico, del nivel semántico/conceptual. No obstante, tal y como apunta Francis (2005), es conveniente definir el significado con el que se van a usar los términos 'léxico', 'semántico' y 'conceptual', ya que a menudo en la literatura se utiliza cada uno de estos mismos términos con distintas acepciones, pudiendo llevarnos a confusión en un aspecto clave para la comprensión del tema que estamos tratando.

Por 'nivel léxico' nos referiremos aquí a las representaciones mentales que los hablantes tenemos de las etiquetas verbales de las palabras (forma ortográfica y fonológica)[1].

La definición clara y precisa de qué se entiende por 'semántico' y qué por 'conceptual' es algo más complicada. Por 'conceptos' nos estaríamos refiriendo a toda idea que un ser humano pueda llegar a aprender o comprender, pero en el momento en que cada concepto pasa por el filtro de la experiencia particular de una persona, éste cambia. Sin embargo, a pesar de las diferencias interpersonales somos capaces de realizar una correspondencia bastante fiable entre el lenguaje y el sistema conceptual. Una manera de explicar cómo es esto posible es recurriendo a la semántica: la representación semántica es el concepto al que se refiere una palabra concreta, o bien es la correspondencia entre una palabra y su concepto (Francis, 2005). Así, ambos términos se encuentran íntimamente relacionados y resulta muy difícil distinguirlos operacionalmente para estudiarlos de forma independiente, aunque algunos autores defienden su separación (ej., Pavlenko, 1999) argumentando que si son términos distintos,

[1] Aunque en el presente trabajo nos vamos a referir únicamente a la información ortográfica y fonológica dentro del nivel léxico, algunos autores sitúan también dentro de este nivel la información morfológica y/o sintáctica. Otros, en cambio, sitúan este tipo de información entre el nivel léxico y el semántico. (Véase Sánchez-Casas y García-Albea, 2005, para más información).

entonces deberían ser separables. Pero experimentalmente resulta poco plausible poder hacer tal diferenciación (Francis, 2005) puesto que si quisiéramos estudiar aquellos conceptos que no son representaciones semánticas de palabras no podríamos hacerlo empleando estímulos léxicos. Por otra parte, si quisiéramos estudiar aquellos conceptos que sí son representaciones semánticas de palabras, ambos términos estarían tan imbricados que no sería posible separarlos. Por lo tanto, aunque en este trabajo nos referiremos básicamente a la representación lexicalizada de los conceptos (semántica), optaremos por usar ambos términos conjuntamente (ej., nivel semántico/conceptual) o indistintamente, como si fueran términos intercambiables.

Además de la distinción dentro de la memoria bilingüe de dos niveles (i. e.: nivel léxico y semántico/conceptual), otro hecho generalmente aceptado es que el nivel conceptual se halla compartido por las lenguas del bilingüe —dejando de lado de momento la manera en que se representa la información en dicho nivel. Aunque existen otras propuestas (Jarvis y Pavlenko, 2008; Pavlenko, 1999, 2009), la evidencia empírica de todas ellas descarta la existencia de sistemas completamente independientes para cada lengua y confirma que la representación del significado de las palabras debe ser compartida, aunque no siempre totalmente (ej., palabras abstractas; Francis, 2005). En cambio, respecto al nivel de representación léxico las discrepancias son mayores, existiendo propuestas que postulan la independencia de los léxicos de las dos lenguas (ej., Kroll y Stewart, 1994) y propuestas que sugieren un léxico integrado en un mismo sistema (ej., Dijkstra y van Heuven, 1998, 2002; Kroll y de Groot, 1997).

Si nos centramos en la manera en que se representaría la información en el nivel léxico, de nuevo encontramos diferentes propuestas en función del modelo teórico que adoptemos. Una posibilidad es considerar que las palabras en el nivel léxico estén representadas localmente, de manera que cada palabra sería una unidad completa e independiente de las demás. Una propuesta de este tipo es, por ejemplo, la del Modelo Jerárquico Revisado (MJR; Kroll y Stewart, 1994) o la del Modelo Bilingüe de Activación Interacción en su versión revisada (BIA+; Dijkstra y van Heuven, 2002; van Heuven y Dijkstra, 2010), modelo conexionista donde cada nodo representa un símbolo, ya sean estos palabras, rasgos sub-léxicos, etc. Mientras que otra posibilidad sería considerar que las representaciones de las palabras se encuentran distribuidas en una red de nodos interconectados sin ningún significado particular o valor por sí mismos, pero cuyo patrón general de activación definiría a cada palabra (de Groot, 1992a, 1992b, 1993; Kroll y de Groot, 1997).

La misma distinción entre representaciones locales y distribuidas es aplicable al nivel semántico: hablar de representaciones locales significaría que cada concepto estaría representado por una unidad indivisible de significado, mientras que hablar de representaciones distri-

buidas supondría que los distintos patrones de activación de los nodos de la red determinarían el significado de las palabras.

Así como los distintos modelos de organización de la memoria del bilingüe han hecho propuestas o asunciones respecto a la representación de las palabras en el nivel léxico (puesto que ello determina en parte que se asuman léxicos independientes o un solo léxico integrado), pocos modelos se aventuran a proponer cómo se representan los significados. Quizá el más relevante en este sentido es el Modelo de Rasgos Distribuidos (MRD; de Groot, 1992a, 1992b, 1993; de Groot y Hoeks, 1995; van Hell y de Groot, 1998a, 1998b), que considera que el nivel conceptual está formado por representaciones distribuidas a través de una red de nodos.

El presente trabajo toma como base, principalmente, las predicciones del MJR por un lado, y el MRD por otro. El motivo de esta elección estriba en la adecuación de dichos modelos para abordar nuestro objetivo general de examinar cómo se establecen las conexiones entre las representaciones léxicas y semántico/conceptuales en el aprendiz de una segunda lengua. En concreto, el MJR hace predicciones claras acerca de cómo se desarrollan dichas conexiones a medida que el aprendiz adquiere mayor competencia en su segunda lengua. Por su parte, el MRD además de permitir hacer predicciones similares a las del MJR, implementa una propuesta del nivel semántico/conceptual que permite dar cuenta del efecto de algunas variables no tanto relativas a los hablantes, sino a las propias características de las palabras. En los siguientes apartados se examinarán en detalle los dos modelos que nos han servido como marco teórico a lo largo de todo el trabajo experimental.

1.2.- Modelos de organización de la memoria bilingüe

1.2.1.- El Modelo Jerárquico Revisado

Podemos decir sin miedo a ser injustos con otras propuestas, que el MJR (Kroll y Stewart, 1994) ha sido el modelo dominante en los estudios relativos a la organización de la memoria del bilingüe durante los últimos 15 años. Este modelo, no obstante, es el resultado de la evolución de una serie de modelos jerárquicos previos, los cuales parten del consenso al que se llegó alrededor de los años 80, de considerar la separación de los léxicos de ambas lenguas y un nivel semántico/conceptual integrado. Con estos tres elementos en común, las diversas propuestas diferían únicamente en la naturaleza de las conexiones entre los distintos niveles de representación y en el peso de dichas conexiones. De esta forma, Potter, So, Von Eckardt y Feldman (1984) propusieron la hipótesis de la asociación de palabras y la hipótesis de la mediación conceptual (véase Figura 1).

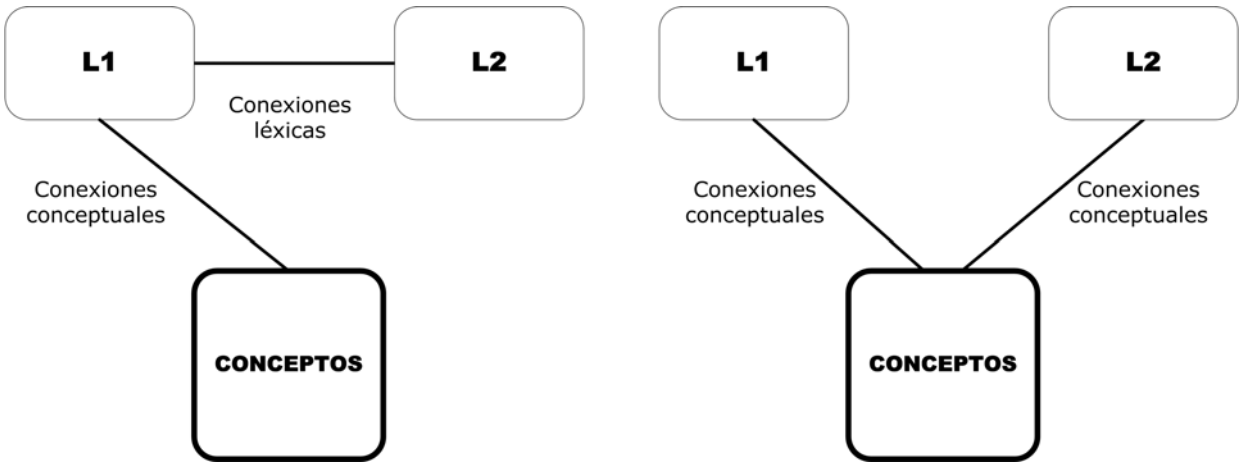

Figura 1: El Modelo de Asociación de Palabras (izquierda) y el Modelo de Mediación Conceptual (derecha) (adaptado de Kroll y de Groot, 1997).

El Modelo de Asociación de Palabras establece conexiones en el nivel léxico entre la L2 y la L1, mientras que con el nivel conceptual únicamente hay conexiones directas a partir de la L1, de manera que para utilizar la L2 el hablante debería pasar siempre por las representaciones correspondientes en la L1. En cambio, el Modelo de Mediación Conceptual no contempla conexiones léxicas entre las dos lenguas, pero sí sería posible acceder directamente al nivel conceptual desde la L2.

Mientras que en el trabajo de Potter et al. (1984) los datos apoyaron la hipótesis de la mediación conceptual, otros estudios posteriores que examinaron a bilingües menos competentes obtuvieron resultados distintos (ej., Chen y Leung, 1989; Kroll y Curley, 1988). En concreto, cuando en estos trabajos los bilingües estudiados tenían una buena competencia en la L2, los resultados apoyaban, de la misma forma que en Potter et al. (1984), la hipótesis de la mediación conceptual. En cambio, si el nivel de competencia de los bilingües era bajo, los resultados apoyaban la hipótesis de la asociación de palabras. Así, se propuso que podía haber un cambio desde el Modelo de Asociación de Palabras hasta el Modelo de Mediación Conceptual a medida que el bilingüe iba adquiriendo una mayor competencia en su segunda lengua. Esto llevó a proponer el que se conoce como Modelo Jerárquico Revisado (Kroll y Stewart, 1994; véase Sánchez-Casas, 1999, para una revisión histórica detallada de la evolución de los modelos).

Dada la repercusión que ha tenido este modelo en el estudio de la organización de la memoria bilingüe y la relevancia teórica para los objetivos que persigue el presente trabajo, es conveniente describir este modelo con cierto detalle.

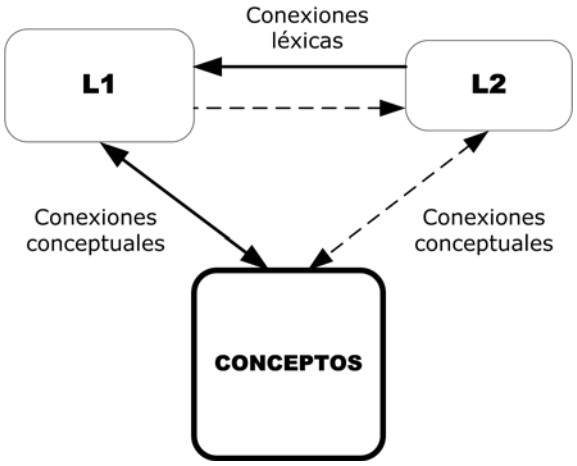

Figura 2: Modelo Jerárquico Revisado (adaptado de Kroll y Stewart, 1994).

El modelo presenta la división clásica propia de los modelos jerárquicos: un único sistema conceptual y un nivel léxico con representaciones independientes para cada lengua (véase Figura 2). No obstante, el léxico de la segunda lengua se encuentra representado con un tamaño algo menor al de la primera lengua dado que se supone que el número de palabras que el bilingüe conoce en su L2 será menor que en la L1. Sobre las conexiones entre niveles, se puede acceder al nivel conceptual desde ambos léxicos, aunque entre la L1 y el nivel conceptual dichas conexiones serían más robustas (flechas continuas) que entre la L2 y el nivel conceptual (flechas discontinuas). Entre léxicos también existen conexiones, aunque en la dirección L2 a L1 nos encontramos con conexiones más fuertes que en la dirección opuesta.

Lo más interesante de este modelo, sin embargo, es la propuesta que hace acerca del desarrollo de las conexiones léxicas y conceptuales en el bilingüe en función de su nivel de competencia. Durante la etapa inicial de la adquisición de la segunda lengua, los bilingües enfrentados a una tarea de traducción harían uso principalmente de las conexiones léxicas entre la L2 y la L1 (i. e.: ruta léxica), puesto que las conexiones de la L2 con el nivel conceptual no estarían suficientemente desarrolladas. En esta etapa, la actuación del bilingüe en la tarea se vería afectada en mayor medida por variables relativas a la forma ortográfica y/o fonológica de las palabras (ej., parecido ortográfico), más que por variables relacionadas con el significado. En cambio, con el aumento de la competencia en la segunda lengua se verían fortalecidas las conexiones directas entre el léxico de la L2 y el nivel conceptual, de manera que pudiendo hacer uso de esa ruta (i. e.: ruta conceptual) el bilingüe mejoraría su actuación, y como consecuencia estaría más influido por la manipulación de variables semánticas (ej., tipo de relación entre palabras). Cabe señalar, sin embargo, que las conexiones léxicas entre la L2 y la L1 no se perderían, por lo cual incluso los bilingües competentes seguirían siendo sensibles a la manipulación de variables referidas a la forma de las palabras.

A pesar de la posición preponderante de esta propuesta acerca de la organización de la memoria bilingüe, el MJR no está exento de críticas. Recientemente Brysbaert y Duyck (2010) han cuestionado varias de las asunciones del modelo. Por ejemplo, estos autores critican la independencia de los léxicos de las dos lenguas que presupone el MJR, en base al gran corpus de evidencia que parece indicar que el acceso al nivel léxico no es selectivo (i. e.: durante el proceso de reconocimiento de palabras se tendrían en cuenta las palabras de ambas lenguas, y no únicamente las palabras de la lengua que se estuviera usando). Sin embargo, un acceso no selectivo no implica necesariamente un nivel léxico integrado para las dos lenguas, siendo perfectamente posible la existencia de un nivel léxico con representaciones independientes para cada lengua y un acceso no selectivo a ellas (Kroll, van Hell, Tokowicz y Green, 2010; van Heuven, Dijkstra y Grainger, 1998).

Otra de las críticas de Brysbaert y Duyck (2010) al MJR, atañe al nivel conceptual, donde según el MJR toda la información ahí contenida sería independiente de las lenguas del bilingüe. Brysbaert y Duyck recurren a la propuesta de Paradis (1997) para destacar que esto podría no ser así. Este autor distingue un nivel léxico, pero lo que en esta introducción estamos considerando como un único nivel indistinguible para lo semántico/conceptual, Paradis lo separa en dos: un nivel para la información semántica y un nivel para la información conceptual. El nivel conceptual contendría la información que es compartida por todas las lenguas del bilingüe (i. e.: independiente de la lengua), mientras que el nivel semántico sería dependiente de la lengua ya que contendría aquellos matices más sutiles propios de cada idioma que se perderían si la información fuera independiente de la lengua. El escritor argentino Jorge Luis Borges hablaba en una entrevista de la imposibilidad de traducir a otros idiomas la frase en español: 'estaba solita'. Se acercaría la traducción inglesa '*she was all alone*', pero no transmitiría exactamente el mismo mensaje. Es este tipo de información idiosincrática de una lengua la que formaría parte del nivel semántico. Partiendo de aquí, Brysbaert y Duyck (2010) presentan algunas evidencias a favor de la existencia de un almacenamiento dependiente de la lengua. Sin embargo, el MJR no hace ninguna propuesta acerca de cómo se representaría u organizaría la información dentro del nivel conceptual, pero podría existir algún tipo de arquitectura que permitiera a la vez un único nivel semántico/conceptual independiente de la lengua, y que a la vez permitiera explicar la existencia de los matices propios de los idiomas (Kroll et al., 2010; ej.: un nivel semántico distribuido en nodos cuyos nodos fueran los mismos para todas las lenguas, y lo que dependiera de cada una de ellas fueran los enlaces entre los nodos y las formas léxicas de las palabras).

En conclusión, esta última crítica de Brysbaert y Duyck (2010) no es especialmente conflictiva para el modelo, pero sí resalta una carencia importante: la falta de concreción acerca de la estructura interna del nivel semántico/conceptual. Puesto que esta cuestión es objeto de especial interés en esta tesis, hemos adoptado también como marco de referencia otro modelo que sí aborda este nivel de representación y que describimos a continuación.

1.2.2.- El Modelo de Rasgos Distribuidos

A pesar de la aparente sencillez de la propuesta del MRD, este modelo resulta muy potente a la hora de explicar cómo se podrían estar produciendo diversos resultados experimentales obtenidos en el ámbito bilingüe del reconocimiento léxico de palabras, tal y como veremos más adelante. La idea es sencilla: existen dos niveles de representación (léxico y conceptual), donde el nivel conceptual está formado por una serie de nodos. Un nodo en el nivel léxico

(cuya naturaleza no se detalla) tendría una serie de conexiones con una serie de nodos del nivel conceptual que conformarían el significado de la palabra. Ante la presentación de una palabra, cada uno de los nodos conceptuales vinculados a ella recibirían una parte de activación excitatoria (de Groot, 1992a; véase Figura 3).

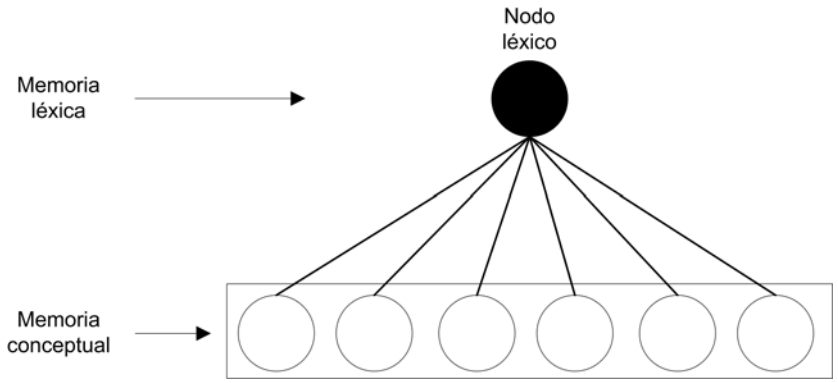

Figura 3: Modelo de Rasgos Distribuidos (adaptado de de Groot, 1992a).

En el caso del léxico bilingüe, una palabra podría activar exactamente los mismos rasgos semánticos que la traducción de la palabra en la otra lengua, en el caso de significar exactamente lo mismo en ambas lenguas (ej.: padre y 'pare' en catalán). O bien, en el caso de tratarse de palabras ambiguas o de palabras cuyo significado no se solapa totalmente con el significado de la otra lengua (ej.: juicio y 'seny' en catalán), ambas palabras solamente compartirían parte de los rasgos y por lo tanto de la activación (véase Figura 4).

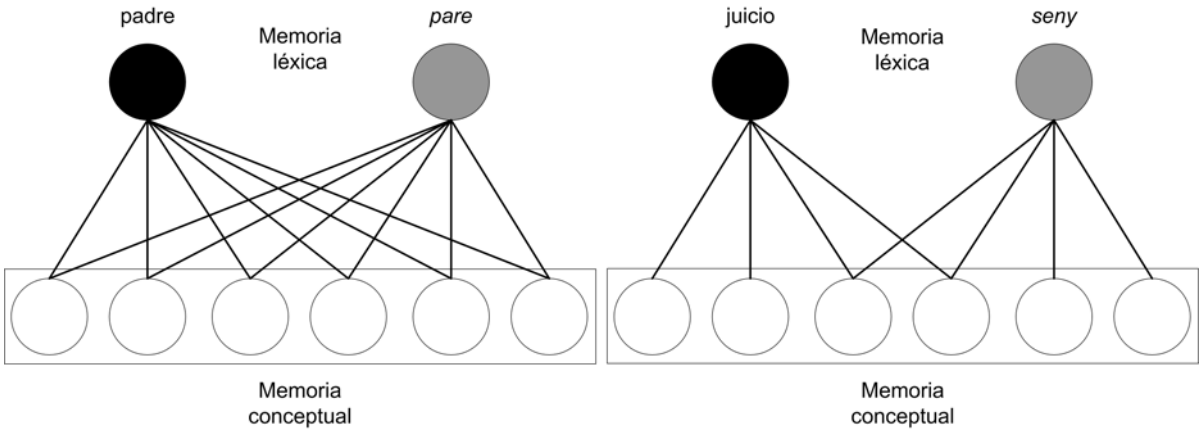

Figura 4: Modelo de Rasgos Distribuidos. Arriba, traducciones con exactamente el mismo significado en ambas lenguas; abajo, traducciones sin solapamiento absoluto de significados (adaptado de de Groot, 1992a).

Aunque este modelo y el MJR no son necesariamente incompatibles sino más bien complementarios, lo cierto es que algunas propuestas basadas en el MRD permiten explicar también las diferencias entre la L1 y la L2 en función del nivel de competencia. Por ejemplo, Kroll y de Groot (1997) propusieron una versión del modelo en la que tanto la ortografía y la fonología de la palabra (nivel léxico) como su significado (nivel semántico/conceptual) estarían representados de forma distribuida a través de un conjunto de nodos (véase Figura 5). Una propuesta de este tipo, no obstante, requiere postular un nivel intermedio específico de cada lengua conectando los nodos léxicos y semánticos. Este nivel intermedio es el de los *lemmas*, que contienen información sintáctica y que mediaría entre la activación de los otros dos niveles durante el procesamiento de las palabras.

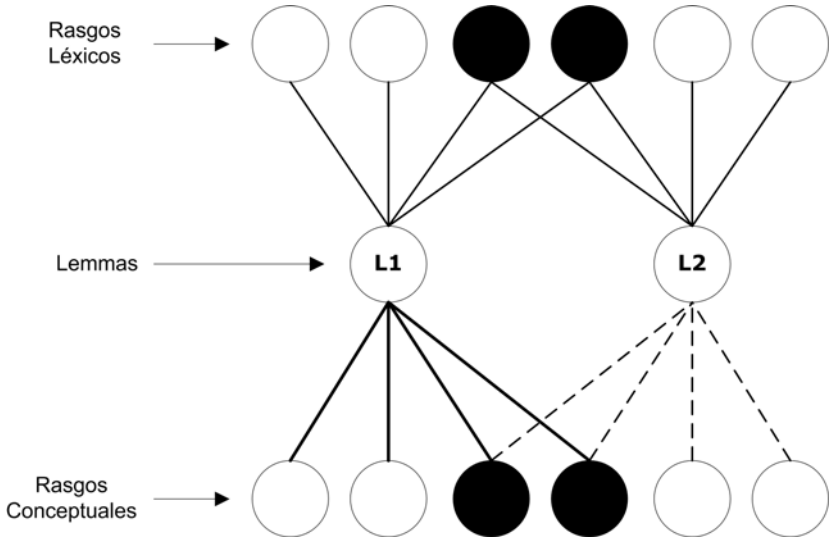

Figura 5: Modelo de Representaciones Léxicas/Conceptuales Distribuidas (adaptado de Kroll y de Groot, 1997).

Este modelo permite dar cuenta de las asimetrías en las que se basa el MJR: nótense las líneas discontinuas que unen el nivel de los *lemmas* de la L2 con el nivel semántico/conceptual, indicando que la correspondencia entre la forma y el significado en la L2 es más débil que en la L1 en las primeras etapas de adquisición de la segunda lengua. Según fuera aumentando el nivel de competencia, la correspondencia entre forma y significado sería más fuerte, pudiéndose alcanzar la misma fuerza en las dos lenguas en los bilingües competentes equilibrados.

La propuesta de un nivel de *lemmas* (véase Levelt, 1989,1999a, 1999b; Levelt, Roelofs y Meyer, 1999) es en la actualidad generalmente aceptada y este nivel se ha incorporado en los modelos de producción. Sin embargo, este modelo no ha tenido la repercusión que han tenido

otros modelos y, según nuestro conocimiento, no hay estudios de traducción con bilingües en los que se investigue dicho nivel de representación (específico para cada lengua) y su papel en las conexiones léxico-conceptuales en el ámbito de la comprensión.

Dado que esta propuesta proporciona una explicación de la asimetría en el acceso al nivel conceptual en términos parecidos a los del MJR, y permite formular hipótesis más precisas sobre la representación de las palabras en el nivel conceptual, formó parte junto con el MJR de los modelos teóricos de referencia del segundo trabajo presentado en esta tesis. No obstante, los trabajos posteriores que se han centrado en estas cuestiones han adoptado una propuesta más reciente basada en el MRD y que sí se ha puesto a prueba en el ámbito de la comprensión (Duyck y Brysbaert, 2004; Schoonbaert, Duyck, Brysbaert y Hartsuiker, 2009).

La propuesta de Duyck y Brysbaert (2004) sugiere una explicación alternativa de los cambios que acontecen como resultado de una mayor competencia en la segunda lengua. Mientras que el MJR propone que el acceso al nivel conceptual es cualitativamente distinto en función de la lengua desde la que se pretende acceder (principalmente la ruta conceptual para la L1 y la ruta léxica para la L2), esta nueva versión del MRD defiende un único mecanismo de acceso desde ambas lenguas al nivel semántico/conceptual, que estaría constituido por representaciones distribuidas. En este caso, la asimetría en el acceso al nivel conceptual propuesta por el MJR se explicaría en este modelo por diferencias puramente cuantitativas: la representación de una palabra en la L1 y la de la misma palabra en la L2, activarían distinto número de nodos semánticos compartidos, siendo la representación para la L2 de una riqueza semántica menor que para la L1, en el caso de aprendices o bilingües no equilibrados (Duyck y Brysbaert, 2004; Schoonbaert et al., 2009; van Hell y de Groot, 1998a; véase Figura 6).

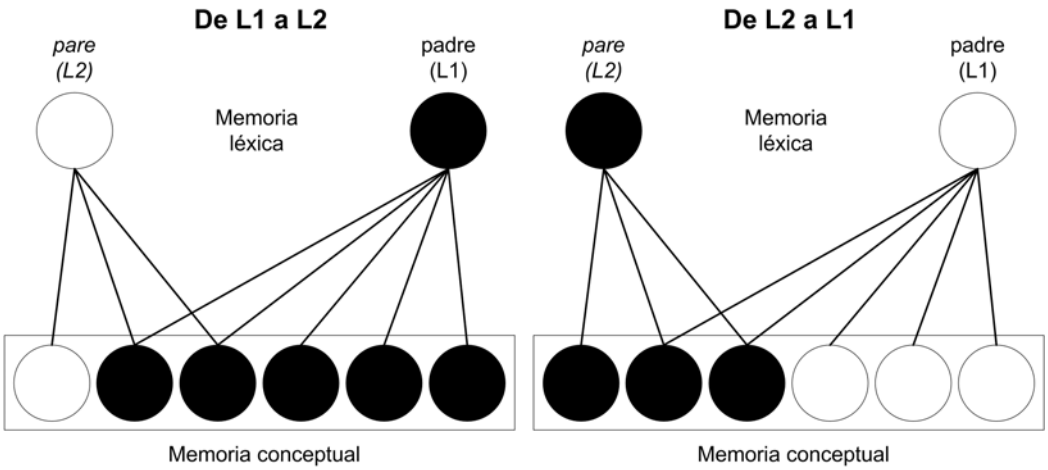

Figura 6: Modificación del Modelo de Rasgos Distribuidos dando cuenta de las diferencias presentes en la traducción (adaptado de Schoonbaert et al., 2009).

De esta manera, al traducir de L1 a L2 el paso inicial por la L1 activaría más nodos del nivel conceptual que al traducir de L2 a L1, donde el paso inicial por la L2 activaría un menor número de nodos semánticos. Tanto el aprendiz como el bilingüe accederían al sistema conceptual de la misma manera, pero el acceso desde la palabra en la L2 no permitiría recuperar toda la información semántica representada.

Como se ha podido comprobar, si bien las arquitecturas de los sistemas que proponen los distintos modelos (por un lado el MJR y el MRD en la versión de Kroll y de Groot, 1997, y la versión más reciente del MRD por otro) tienen semejanzas entre sí, difieren en aspectos clave de su funcionamiento que conducen a distintas propuestas acerca de las diferencias encontradas entre el procesamiento de las palabras en L1 y en L2. En el apartado siguiente veremos cómo se pueden explicar los resultados experimentales existentes en la literatura en base a las propuestas de estos modelos.

1.3.- Desarrollo de las conexiones léxicas y conceptuales en la adquisición de la segunda lengua

Como se ha dicho anteriormente, el MJR (Kroll y Stewart, 1994) ha sido el modelo dominante en los estudios relativos a la organización de la memoria del bilingüe, durante los últimos 15 años. También como mencionamos anteriormente una importante aportación de este modelo es su propuesta acerca de cómo se desarrollan las conexiones entre las dos lenguas tanto en el nivel léxico como en el conceptual. El modelo propone que el bilingüe principiante en su segunda lengua a la hora de acceder al significado se basa principalmente en las conexiones léxicas existentes entre la L2 y la L1, ya que las conexiones de la L2 con el nivel conceptual son todavía débiles. En cambio, el bilingüe competente es capaz de acceder desde la L2 directamente al nivel conceptual ya que las conexiones entre estos dos niveles se han fortalecido. Por lo tanto, existirían dos rutas distintas para acceder al nivel conceptual: una ruta directa que uniría la L1 con el nivel conceptual (y también la L2 con el nivel conceptual en el caso de los bilingües competentes) y una ruta léxica que conectaría la L2 con la L1, y ésta con el nivel conceptual (véase Figura 2). Por lo tanto, lo que se propone es un acceso cualitativamente diferente al nivel conceptual dependiendo de la lengua que se esté usando y del nivel de competencia en la segunda lengua. Además, de todo ello se deriva otra predicción. Por un lado, el rendimiento de los aprendices en tareas como la de traducción estaría más afectado por variables formales que semánticas por el hecho de hacer un uso principal de la ruta léxica. En cambio, en el caso de los bilingües competentes se esperaría un mayor efecto de variables semánticas dado que pueden acceder directamente a los conceptos a partir de su segunda lengua. No obstante, las conexiones léxicas entre las lenguas no desaparecen en estos bilingües, con lo que también se esperarían efectos de las manipulaciones relacionadas con la forma de las palabras. Por otra parte, las manipulaciones semánticas deberían afectar más cuando la dirección de la traducción es de la L1 a la L2, que cuando es de la L2 a la L1, ya que en el primer caso la L1 haría un uso preferente de la ruta conceptual.

En cambio, Duyck y Brysbaert (2004) sugieren una versión del MRD en la que con una única ruta de acceso desde ambas lenguas al nivel semántico/conceptual, se podría explicar la asimetría en la traducción que propone el MJR. Dicha explicación pasaría por asumir que la representación de una palabra en la L1 activaría un mayor número de nodos semánticos distribuidos que la misma palabra en la L2, de manera que al traducir de L1 a L2 la segunda palabra dispondría de un mayor número de nodos activados en su representación que la segunda palabra en caso de que la traducción fuera en la dirección de L2 a L1.

En los subapartados que se presentan a continuación comprobaremos si la evidencia experimental disponible en la literatura apoya o no ambas concepciones acerca de cómo se organiza la memoria léxica y semántica del bilingüe. En primer lugar repasaremos la evidencia que pone a prueba la posibilidad de acceder directamente al nivel conceptual desde la L2 del bilingüe poco competente, y también revisaremos los pocos estudios que ponen a prueba explícitamente la propuesta evolutiva de las conexiones del bilingüe que hace el MJR. Pero además de centrarnos en el nivel de competencia de los bilingües, también examinaremos otra variable a menudo olvidada o confundida en la literatura: la edad de adquisición de la segunda lengua, que como veremos podría estar contribuyendo a explicar los efectos atribuidos al nivel de competencia, en el sentido de que no fuera suficiente con un buen nivel de conocimiento de la segunda lengua para acceder directamente al nivel semántico/conceptual, sino que hiciera falta también haber aprendido dicha L2 en etapas tempranas de la vida.

En el segundo subapartado continuaremos examinando cómo se produce el acceso al nivel semántico, pero en lugar de centrarnos en el aspecto evolutivo de las conexiones entre niveles, estudiaremos si dicho acceso es distinto en función de la lengua desde la que se lleve a cabo. Esta cuestión ha sido tradicionalmente estudiada empleando el paradigma de *priming* semántico y/o de traducción, que proporciona una manera de poner a prueba la capacidad de los bilingües de acceder directamente al nivel conceptual desde cada una de sus lenguas sin necesidad de recurrir a la otra (sin mediación léxica).

Todo ello nos llevará a considerar una última variable, en este caso referida a características propias de las palabras y no tanto a características de los bilingües: el grado de relación semántica entre palabras y su influencia en el acceso y representación en el nivel conceptual. El interés del estudio de esta variable reside en el hecho de que puede ser muy útil para contrastar las predicciones de los modelos de referencia en cuanto al acceso diferencial al nivel conceptual en función de si se lleva a cabo desde la L1 o desde la L2. Aunque la literatura que estudia explícitamente el papel del grado de relación semántica entre palabras en el acceso al

nivel conceptual es escasa, repasaremos los trabajos que existen realizados con monolingües y con bilingües.

1.3.1.- El problema del acceso al nivel semántico/conceptual desde la segunda lengua: la ruta léxica vs. la ruta conceptual

Recordemos que el MJR hace predicciones acerca del desarrollo de las conexiones léxicas y conceptuales en función del nivel de competencia del hablante bilingüe. Resumida, la propuesta sugiere que durante las etapas iniciales de aprendizaje de una segunda lengua el proceso de traducción de los aprendices sería más sensible a la manipulación de variables relativas a la forma de las palabras, más que a la manipulación de variables relacionadas con el significado, debido a que estos hablantes harían un uso preferente de las conexiones léxicas entre la L2 y la L1. Mientras que en el caso de los bilingües más avanzados en la segunda lengua, las conexiones directas entre el léxico de la L2 y el nivel conceptual estarían muy fortalecidas, de manera que las variables que más influirían en su traducción serían las semánticas. Por lo tanto, según el MJR, el nivel de competencia en la segunda lengua sería clave en el proceso de fortalecimiento de las conexiones léxicas y conceptuales en el bilingüe.

Una manera de poner a prueba estas predicciones del MJR es examinando a aprendices en las primeras etapas de adquisición de su segunda lengua empleando tareas que requieran mediación conceptual. De esta manera, se puede comprobar si los aprendices son capaces de emplear la ruta conceptual a la hora de traducir o si por el contrario únicamente son capaces de emplear la ruta léxica. Un enfoque que aborda esta cuestión ha sido el de estudios realizados con personas a las que se les enseña, en la propia sesión experimental en el laboratorio, un reducido conjunto de palabras en otra lengua distinta a su L1 con el fin de simular el proceso de aprendizaje de la L2. En esta línea, Altarriba y Mathis (1997) y Ferré, Sánchez-Casas y García (2001) proporcionaron evidencia, en sendos trabajos, de mediación conceptual en la segunda lengua en bilingües con una exposición mínima a la L2. Con distintas tareas (tarea de reconocimiento de traducciones en Altarriba y Mathis, 1997 y tarea de Stroop bilingüe en Altarriba y Mathis, 1997 y en Ferré et al., 2001) en las cuales las palabras que los participantes veían en la L2 eran las mismas que habían aprendido previamente, se obtuvieron efectos de interferencia semántica entre lenguas. Este tipo de participantes tenían un conocimiento mínimo de la L2, pero aún así mostraron efectos de interferencia en tareas que requieren acceso al nivel conceptual (véase Comesaña, Perea, Piñeiro y Fraga, 2009, para resultados similares con población infantil). Sin embargo, se ha propuesto que tal situación de aprendizaje podría no ser equiparable a situaciones reales de bilingüismo. El problema principal radica en

que los participantes son entrenados intensivamente en un conjunto muy reducido de palabras (Talamas, Kroll y Dufour, 1999) y se podría argumentar que acaban siendo muy competentes en ese reducido ámbito léxico. Por tanto, si consideramos que técnicamente no son participantes aprendices sino expertos, no es de extrañar que muestren efectos de interferencia semántica.

Sin tener que recurrir a este tipo de entrenamiento intensivo, otros estudios cuestionan las predicciones del MJR en el sentido de hallar mediación conceptual en bilingües con un nivel de competencia bajo en diferentes tareas. Por ejemplo, Dufour y Kroll (1995) empleando una tarea de decisión semántica (i. e.: juzgar si la palabra presentada pertenece a una categoría semántica prefijada) en la que tanto el nombre de la categoría semántica como la palabra objetivo podían estar o bien en inglés (L1) o bien en francés (L2), observaron que su grupo de bilingües poco competentes no parecía estar usando una estrategia de traducción, ya que en dicho caso la condición francés–francés debería haber sido la más lenta por tener que traducir al inglés dos palabras, y en cambio no fue ése el resultado obtenido. Los autores concluyeron que aun en niveles bajos de competencia se estaría empleando información semántica para realizar la categorización. De forma similar, de Groot y Poot (1997) examinaron el rendimiento de tres grupos de holandeses bilingües no equilibrados que diferían en su nivel de competencia en la L2 (inglés) en una tarea de traducción tanto de L1 a L2 como de L2 a L1. Los resultados de dicho estudio, revisados globalmente, mostraron patrones de datos similares en los tres grupos de competencia, y además no hubo diferencias en los resultados en función de la dirección de la traducción, con lo que una vez más nos encontramos con datos que cuestionan las predicciones generales del MJR referentes a la asimetría de las conexiones en los bilingües poco competentes. Finalmente, Frenck-Mestre y Prince (1997) también hallaron evidencias de mediación conceptual con bilingües con un nivel intermedio en su segunda lengua. Estos autores emplearon el paradigma de *priming* semántico. El paradigma de *priming* semántico consiste en la presentación de dos palabras de forma consecutiva. La primera palabra (el *prime*) puede estar relacionada semánticamente con la segunda palabra (el *target*; ej., trigo – cebada) o no estarlo (ej., barro – cebada). El efecto de *priming* semántico se producirá si la respuesta que debe dar el participante sobre el *target* se ve facilitada por la presentación previa del *prime* relacionado, si se compara con el tiempo de respuesta empleado en la respuesta al *target* cuando el *prime* no está relacionado. Volviendo al trabajo de Frenck-Mestre y Prince (1997), estos autores examinaron a un grupo de franceses con un nivel intermedio de inglés en una tarea de decisión léxica con *priming*, consistente en que los participantes tenían que decidir si la secuencia de letras presentada como *target* constituía una palabra o no. Los resultados mostraron efectos de *priming* semántico dentro de la L2 (tarea inglés–inglés) con *primes*

homógrafos cuando el *target* estaba relacionado con el significado dominante del *prime* homógrafo (ej.: la palabra '*right*' [correcto / derecha] facilitaría la decisión léxica del *target* '*correct*' [correcto]).

Si bien los estudios que acabamos de revisar muestran que existe mediación conceptual incluso con bilingües poco competentes, no ponen a prueba directamente las predicciones del MJR, ya que en última instancia lo que este modelo propone es una asimetría en la fuerza de las conexiones léxicas y conceptuales cuando se traduce de L2 a L1, y no una ausencia total de mediación conceptual. Así, para poner directamente a prueba las predicciones del MJR es necesario diseñar una tarea que examine la asimetría en las conexiones, y no solamente la presencia o ausencia de mediación conceptual. Uno de los estudios iniciales más significativos que examinó el papel del nivel de competencia en la L2 poniendo a prueba las predicciones del MJR es el llevado a cabo por Talamas et al. (1999). Estos autores utilizaron una tarea de reconocimiento de traducciones con dos grupos de bilingües de inglés (L1) y español (L2): más y menos competentes en su segunda lengua. En la tarea de reconocimiento de traducciones, el participante ve una palabra en una lengua seguida de una palabra en la otra lengua, y a continuación debe decidir si la segunda palabra es la traducción correcta de la primera. Los estímulos incluían pares de palabras que eran traducciones correctas (ej., *garlic* – ajo) y pares que no lo eran. Estos pares de no traducciones podían estar relacionados en la forma (ej., *garlic* – ojo, donde 'ojo' se parece a la traducción correcta de *garlic*, lo que se conoce como vecinos de traducción) o podían estar relacionados en el significado (ej., *garlic* – cebolla).

La idea subyacente a este procedimiento es la de manipular la relación entre las palabras en las traducciones incorrectas para ver cómo la relación entre ambas (léxica o semántica) afecta a la velocidad y la precisión de respuesta de los participantes. Por ejemplo, supongamos que el siguiente par de no traducciones, 'garlic – ojo', pertenecen respectivamente a la L2 y a la L1 de un aprendiz. En este caso, si el participante está empleando la ruta léxica, la presentación de la palabra *garlic* activaría la forma léxica 'ajo', y ésta a su vez activaría todas aquellas representaciones léxicas similares en la forma (entre ellas 'ojo'). De esta forma, la posterior presentación de 'ojo' competiría con la traducción correcta ('ajo') dado que ambas se encontrarían activas en la memoria. Esta competición resultaría en una interferencia en la velocidad de respuesta del participante. Además, cuanto mayor fuera el uso de la ruta léxica sobre la conceptual, mayor sería dicho efecto de interferencia. En cambio, la presentación de la palabra 'cebolla' tras la aparición de *garlic* no debería causar interferencia si efectivamente se está empleando la ruta léxica, ya que la relación entre ambas palabras es, en este caso, solamente semántica. Por tanto, la representación léxica de 'cebolla' no debería activarse ante la aparición de *garlic* y no supondría un problema decidir que ambas palabras no son traducciones.

Además, cuanto mayor fuera el uso de la ruta léxica sobre la conceptual, menor interferencia semántica se esperaría.

Por otra parte, los bilingües competentes deberían comportarse de forma opuesta a los aprendices, ya que si se emplea más la ruta conceptual que la ruta léxica durante el proceso de traducción, se incrementaría también la posibilidad de que *garlic* activara la palabra 'cebolla', y la posterior aparición de ésta sumada a su anterior activación provocaría interferencia semántica. Pese a todo, como las conexiones léxicas aún estarían activas en estos bilingües también deberían mostrar cierta interferencia causada por la forma.

Retomando el experimento de Talamas et al. (1999), las variables que se medían eran el tiempo de reacción y el número de errores, con la intención de determinar el efecto de interferencia producido por el parecido entre las dos palabras en el caso de las no traducciones (ya fuera en forma o en significado). El tamaño del efecto de interferencia se calculaba como la diferencia entre el tiempo que se tardaba en responder ante la presentación de los pares relacionados (ej., *garlic* – cebolla) y el tiempo de respuesta ante pares de control no relacionados (ej., *garlic* – lana).

El patrón de resultados obtenido confirmó las predicciones del MJR. Es decir, el grupo de bilingües menos competente en la L2 mostró un efecto de interferencia mayor cuando la manipulación era formal (en respuesta a los pares de palabras parecidas en la forma a sus traducciones; ej., *garlic* – ojo) que cuando era semántica (ej., *garlic* – cebolla). En cambio, el patrón fue justamente el inverso para el grupo de bilingües más competente (i. e.: un mayor efecto de interferencia por el parecido semántico que por el parecido formal), apoyando así la hipótesis de un mayor uso de la ruta léxica en el proceso de traducción por parte de los bilingües menos competentes en la L2 y de un mayor uso de la ruta conceptual por parte de los más competentes.

Hay dos aspectos de los resultados que es importante resaltar. Por un lado, los bilingües más competentes mostraron cierta influencia del parecido léxico; por otro lado, aunque los bilingües menos competentes no fueron más lentos en la condición de parecido semántico, sí cometían un mayor número de errores (lo cual indicaría cierta mediación conceptual) coincidiendo con los estudios previos que habían mostrado evidencia de mediación conceptual en los bilingües menos competentes (Altarriba y Mathis, 1997; de Groot y Poot, 1997; Dufour y Kroll, 1995; Ferré et al., 2001; Frenck-Mestre y Prince, 1997). Para explorar estos datos con mayor detalle los autores realizaron un análisis *post hoc*, dividiendo los estímulos experimentales en dos grupos: uno con los pares semánticamente muy similares y otro con los menos similares. Estos análisis revelaron que el grupo de bilingües menos competentes era sensible a

la interferencia semántica pero solamente con los pares muy similares, mientras que el grupo de bilingües más competentes mostraba interferencia en ambos tipos de pares.

Más recientemente, Sunderman y Kroll (2006) llevaron a cabo un estudio similar al que acabamos de revisar con el fin de proporcionar evidencia adicional acerca de la validez de las predicciones del MJR. De la misma manera que Talamas et al. (1999), seleccionaron a dos grupos de hablantes de inglés que estaban aprendiendo español: uno más competente y otro menos competente. La tarea que realizaron los participantes fue de nuevo una tarea de reconocimiento de traducciones y también se incluyeron, entre otros, vecinos de traducción (ej., cara – *fact* [hecho], donde *fact* se parece a *face* [cara]), así como pares de no traducciones que se parecían en el significado (ej., cara – *head* [cabeza]). Los resultados mostraron que el rendimiento de los participantes de ambos grupos se veía influido tanto por la manipulación formal como por la manipulación semántica. De nuevo, al igual que Talamas et al. (1999), Sunderman y Kroll realizaron un análisis *post hoc* con el fin de comprobar si la interferencia del significado dependía del grado de relación que tuvieran entre sí las palabras. Efectivamente, se observó que a mayor semejanza entre las palabras mayor efecto de interferencia, pero este hecho se daba por igual en ambos grupos de bilingües (i. e.: más y menos competentes), no coincidiendo así con los resultados obtenidos por Talamas et al. (1999).

En cuanto a los vecinos de traducción, sólo los menos competentes fueron sensibles a este tipo de manipulación. Este último dato es consistente con el MJR, ya que demuestra que los bilingües menos competentes todavía mantendrían enlaces fuertes entre la L2 y la L1 mientras que los más competentes no. En el ejemplo anterior (i. e.: cara – *fact*), los menos competentes accederían a la traducción de cara (*face*) para realizar la tarea, y sus respuestas se verían afectadas por el parecido con *fact*. Los más competentes accederían directamente al concepto de cara y al de *fact*, de manera que sus respuestas no se verían influidas por el parecido anterior. En líneas generales, este aspecto coincide con los resultados obtenidos por Talamas et al. (1999) en el sentido de que en los inicios de la adquisición de una segunda lengua los bilingües son más sensibles al parecido formal, pero esta sensibilidad disminuye con el aumento del nivel de competencia.

Es importante destacar que en ambos estudios (Sunderman y Kroll, 2006; Talamas et al., 1999), en sendos análisis *post hoc* se observó que el grado de interferencia semántica estaba modulado por el grado de relación que tuvieran entre sí las palabras, de manera que a mayor semejanza, mayor efecto de interferencia se observaba. Este hecho pone de relieve que además de las variables relativas a los hablantes bilingües (como puede ser el nivel de competencia en la segunda lengua) existen también variables relativas a las palabras que pueden

afectar a cómo el hablante accede al nivel semántico. Dada la importancia teórica de este hecho, en el tercer apartado de esta introducción nos centraremos en este tipo de variables y retomaremos los resultados de Talamas et al., 1999 y Sunderman y Kroll, 2006 para examinar sus implicaciones teóricas con mayor detalle.

Volviendo a los estudios revisados anteriormente, algunos de ellos (ej., Dufour y Kroll, 1995; Talamas et al., 1999) han usado en sus respectivos grupos de participantes a bilingües tempranos (i. e.: que han aprendido su segunda lengua en una edad temprana de la vida) en su grupo de bilingües más competentes, mientras que han usado a bilingües tardíos (i. e.: que han aprendido su segunda lengua en una edad no temprana de la vida) en su grupo de bilingües menos competentes. De este modo, a menudo se han confundido las variables competencia y edad de adquisición. Sin embargo, hay estudios que sugieren que el procesamiento semántico de las palabras en L2 puede estar modulado por esta última variable. En concreto, este tema ha sido abordado en trabajos como los de Kotz (2001) y Kotz y Elston-Güttler (2004). Estos autores utilizaron una tarea de decisión léxica con *priming* semántico dentro de la L2 (inglés). La L1 era el castellano en el estudio de Kotz (2001) y el alemán en Kotz y Elston-Güttler (2004). Los bilingües participantes pertenecían a dos grupos distintos en función de su nivel de competencia (más y menos competentes) y dentro del grupo de mayor competencia se dividían según la edad de adquisición (temprana y tardía, considerando los 4 años como punto de división). Las medidas empleadas fueron los TR y los potenciales evocados (PE). Los resultados en los TR mostraron que el patrón de efectos de *priming* era el mismo en los dos grupos de bilingües competentes (independientemente de su edad de adquisición de la L2), mientras que en los datos de PE se observó que el patrón de efectos de *priming* era el mismo entre bilingües competentes tardíos y bilingües menos competentes, pero distinto al de los bilingües tempranos. Por lo tanto, tanto el nivel de competencia como la edad de adquisición serían variables a considerar.

Otro trabajo que ha tenido en cuenta la edad de adquisición de la segunda lengua es el de Silverberg y Samuel (2004), cuyos resultados no coinciden totalmente con los de Kotz (2001) y Kotz y Elston-Güttler (2004). Silverberg y Samuel emplearon de nuevo tres grupos de participantes: bilingües tempranos (considerando en este caso los 7 años como punto de división) y bilingües tardíos más y menos competentes en su L2. Las lenguas implicadas eran el español (L1) y el inglés (L2) y la tarea era de decisión léxica con un paradigma de *priming* semántico. En este caso se observó que únicamente los bilingües tempranos mostraban efectos de *priming* semántico, señalando así la edad de adquisición de la L2 como la variable realmente

importante a la hora de determinar si el bilingüe hace uso de la ruta léxica y/o de la ruta conceptual para acceder al nivel semántico.

Sin embargo, es importante señalar que en el trabajo de Silverberg y Samuel (2004) se examinó únicamente la dirección de L2 a L1, y que los estudios de Kotz y colaboradores fueron llevados a cabo dentro de la L2, y por lo tanto no se pueden considerar propiamente estudios realizados a través de lenguas. Lo que sí parece claro es que la edad de adquisición no ha sido suficientemente considerada en la literatura bilingüe y puede estar jugando su papel en el desarrollo de las conexiones directas entre la L2 y el nivel conceptual. El MJR no hace predicciones sobre esta variable ya que no se encuentra contemplada en el modelo. No obstante, asume que es el nivel de competencia lo que determina que el acceso al sistema conceptual pueda efectuarse de forma directa tanto desde la L1 como desde la L2.

Teniendo en cuenta todo lo anterior, nos planteamos en esta tesis abordar, en primer lugar, el objetivo de examinar las propuestas de los dos modelos de referencia (i. e.: MJR y MRD) en cuanto al desarrollo de las conexiones léxicas y conceptuales en el bilingüe y el uso diferencial de las rutas léxica y conceptual en función su nivel de competencia en la L2. Para ello, y aunque habitualmente los estudios emplean solamente dos niveles de competencia, empleamos a tres grupos de bilingües con distinta competencia en su L2 con la intención de observar mejor las diferentes etapas de adquisición de la segunda lengua. Pero también quisimos tener en cuenta la edad de adquisición de la L2 utilizando la tarea de reconocimiento de traducciones en lugar del paradigma de *priming* semántico (utilizado por Kotz, 2001, Kotz y Elston-Güttler, 2004 y Silverberg y Samuel, 2004) ya que, además de la novedad que supone examinar la variable 'edad de adquisición' con dicha tarea, nos permitió asegurar que nuestros estudios fueran comparables con la literatura previa acerca de la influencia de la forma y el significado en el acceso al nivel conceptual.

En el apartado que se presenta a continuación seguiremos con el estudio del acceso al nivel conceptual, pero esta vez revisaremos los trabajos que se han centrado en la lengua desde la que se pretende acceder a él.

1.3.2.- El problema de la asimetría en el acceso conceptual: efectos de priming y dirección de acceso

Además de la predicción de que los aprendices de una segunda lengua serían más sensibles a la manipulación de variables relativas a la forma que al significado de las palabras, y lo contrario en el caso de los bilingües competentes, el MJR propone que el acceso al nivel concep-

tual será distinto en función de si se realiza desde la L1 o desde la L2. En concreto, en el caso de los aprendices el acceso a los conceptos desde la L1 sería directo, mientras que en el caso de la L2 estaría mediado a través de la L1. Por otra parte, en el caso de los bilingües competentes se podría acceder directamente desde ambos léxicos. El MRD propone, en cambio, que desde ambos léxicos se accedería de la misma forma al nivel conceptual. No obstante, los bilingües aprendices activarían un número menor de nodos en el nivel conceptual cuando accedieran desde una palabra en la segunda lengua que cuando lo hicieran desde la primera, mientras que los bilingües competentes no deberían mostrar esta diferencia en cuanto a número de nodos semánticos activados desde una u otra lengua.

Tradicionalmente el estudio de estas diferencias en función de la lengua de acceso al nivel semántico se ha llevado a cabo empleando el paradigma de *priming*, ya sea en forma de *priming* semántico o en forma de *priming* de traducción. Como ya hemos comentado anteriormente, el paradigma de *priming* semántico consiste en la presentación de un *prime* que puede estar relacionado semánticamente con el *target* (ej., trigo – cebada) o que no está relacionado con él (ej., barro – cebada). La diferencia entre el tiempo de respuesta al *target* con el *prime* relacionado y el tiempo de respuesta al *target* con el *prime* no relacionado, será el efecto de *priming* semántico obtenido. Este efecto de facilitación se ha observado en monolingües tanto con medidas conductuales como los tiempos de reacción (TR) (véase Neely, 1991 y McNamara y Holbrook, 2003, para revisiones), como con medidas electrofisiológicas como los potenciales evocados (PE) (ej., Anderson y Holcomb, 1995; Holcomb y Neville, 1990; Kreher, Holcomb y Kuperberg, 2006). Mientras que el *priming* semántico puede estudiarse dentro de una misma lengua o a través de lenguas, el *priming* de traducción únicamente puede ser empleado entre lenguas, aunque un equivalente monolingüe al *priming* de traducción sería el *priming* de identidad o de repetición, en el que *prime* y *target* son la misma palabra y el efecto de *priming* que se esperaría obtener sería el máximo posible.

En el ámbito bilingüe el efecto de *priming* semántico se estudia empleando lenguas distintas para el *prime* y el *target*. Se producirá dicho efecto si la presentación de una palabra semánticamente relacionada con el *target* pero en otra lengua (ej., *blat* – cebada; donde el *prime* significa ‘trigo’ en catalán) reduce el tiempo de respuesta en relación con el tiempo empleado frente al *target* precedido por un *prime* no relacionado, también en otra lengua (ej., *fang* – cebada; donde el *prime* significa barro en catalán). También en el ámbito bilingüe podemos hablar de *priming* de traducción, muy similar al *priming* semántico pero donde la primera palabra es la traducción de la segunda (ej., *ordi* – cebada) y se podría considerar que la relación semántica entre las dos palabras es máxima. Igual que en el caso del *priming* semán-

tico, se compara el tiempo de respuesta al *target* precedido por la traducción correcta (ej., *ordi* – cebada), con el tiempo de respuesta al *target* precedido por una palabra no relacionada (ej., *fang* – cebada).

Una interpretación bastante aceptada del efecto de *priming* semántico es que al presentarse la palabra que actúa como *prime*, ésta activa sus correspondientes representaciones en el nivel semántico/conceptual (véase Bueno y Frenck-Mestre, 2002 y Hutchison, 2003, para otras interpretaciones del efecto de *priming*). Si la palabra está semánticamente relacionada con el *target*, algunas de esas representaciones serán comunes, de manera que su preactivación por parte del *prime* supondrá una ventaja que se traducirá en un menor tiempo de reacción. En los hablantes bilingües, si asumimos un nivel semántico/conceptual compartido por sus dos lenguas el efecto de *priming* semántico también debería producirse a través de lenguas, así como también debería observarse *priming* de traducción. Siguiendo la propuesta del MJR este efecto debería observarse al menos en la dirección de L1 a L2 (puesto que la L1 dispone de conexiones directas con el nivel conceptual). El hecho de hallar efectos de este tipo también en la dirección de L2 a L1 sería una prueba de mediación conceptual en la segunda lengua, ya que supondría que la palabra *prime* en L2 habría podido activar las representaciones conceptuales correspondientes. Mientras que si tomamos en consideración el MRD, el efecto de *priming* ya sea semántico o de traducción en la dirección de L1 a L2 se debería a que la palabra de la primera lengua activaría los mismos nodos semánticos (o prácticamente los mismos) que la palabra en la L2 en el caso del *priming* de traducción (véase Figura 6), o una proporción muy parecida en el caso de una relación semántica estrecha. En este caso, recordemos que el modelo propone que las representaciones semánticas a las que se tiene acceso en las etapas iniciales de aprendizaje de una segunda lengua desde las palabras en la L2 son menos 'ricas' que las que se acceden desde las palabras en la L1. De manera que el hecho de encontrar efectos de *priming* semántico/de traducción en la dirección de L2 a L1 supondría que el bilingüe tiene suficiente nivel de competencia como para activar un número suficiente de nodos semánticos desde la L2 que faciliten la decisión sobre la palabra de la L1.

En resumen, ambos modelos predicen una asimetría en la magnitud de los efectos de *priming* esperados en función de la lengua desde la que se accede al nivel semántico/conceptual. Desde el MJR se espera por el uso diferencial de las rutas léxica/semántica que hacen los hablantes en función de la lengua de acceso, y desde el MRD se espera por una cuestión puramente cuantitativa: una lengua es capaz de activar una proporción mayor de nodos semánticos que la otra. Y de nuevo estas predicciones estarían moduladas por el nivel de competencia, ya que si el bilingüe es capaz de utilizar la ruta conceptual desde la L2 (MJR), o si las representaciones conceptuales correspondientes a las palabras de la L2 del bilingüe son igual

de 'ricas' que las de la L1 (MRD), dicha asimetría debería desaparecer. Además de todo esto cabe señalar que según el MRD los efectos de *priming* de traducción deberían ser más fuertes que los efectos de *priming* semántico, ya que el grado de solapamiento en el significado en el caso de la traducción también es mayor que en el caso de las relaciones semánticas.

Revisaremos en primer lugar la literatura que ha examinado la asimetría en los efectos de *priming* de traducción (véase Altarriba y Basnight-Brown, 2007, Duñabeitia, Perea y Carreiras, 2010 y Kiran y Lebel, 2007, para revisiones). Existen alrededor de una veintena de trabajos que han examinado los efectos de *priming* de traducción, aunque no todos han empleado las dos direcciones de traducción posibles. De entre los que sí lo han hecho, la mayoría obtienen los resultados esperados según los dos modelos aquí considerados. Por una parte, algunos estudios obtienen efectos únicamente en la dirección L1-L2 (Dimitropoulou, Duñabeitia y Carreiras, 2011; Gollan, Forster y Frost, 1997; Jiang, 1999; Jiang y Forster, 2001; Jin, 1990). Tomando como ejemplo el trabajo de Dimitropoulou et al. (2011), estos autores llevaron a cabo un experimento en el que pedían a un grupo de griegos aprendices de español que realizaran una tarea de decisión léxica con *priming* de traducción enmascarado (donde el *prime* no es visible). Los resultados mostraron un claro efecto de *priming* de traducción en la dirección L1-L2, y una ausencia total de efectos en la dirección L2-L1. Por otra parte, otros estudios han hallado efectos de *priming* de traducción en ambas direcciones pero asimétricos, siendo mayores en la dirección L1-L2 que en la dirección L2-L1 (Chen y Ng, 1989; Jiang, 1999; Keatley, Spinks y de Gelder, 1994; Schoonbaert et al., 2009). Este es el caso, por ejemplo, de Schoonbaert et al. (2009), quienes emplearon como en el caso de Dimitropoulou et al. (2011) una tarea de decisión léxica con *priming* enmascarado, con holandeses aprendices de inglés. Cabe destacar otro trabajo, realizado por Duyck y Warlop (2009), en el que empleando a holandeses aprendices de francés y la misma tarea que en el estudio de Schoonbaert et al. (2009), a diferencia de toda la evidencia anteriormente citada, obtuvieron un claro efecto de *priming* de traducción de la misma magnitud en ambas direcciones: L1-L2 y L2-L1. Aunque este resultado iría en contra de lo predicho por los modelos (i. e.: MJR y MRD), es hasta el momento la única evidencia con resultados de este tipo, y no está exenta de críticas (Dimitropoulou et al., 2011). Entre otras cosas, este trabajo ha sido criticado por utilizar tan sólo a 24 participantes para 8 condiciones experimentales, lo que hace que la potencia estadística de los datos sea muy baja.

Los resultados que hemos comentado hasta el momento fueron obtenidos empleando a bilingües no equilibrados en sus dos lenguas y (con la excepción de los de Duyck y Warlop, 2009) son consistentes con las predicciones de los modelos que proponen que a medida que

los sujetos tienen una mayor competencia en su L2, mayor facilidad se observa para acceder desde la L2 directamente al nivel conceptual sin mediación de la L1. Esta propuesta gana fuerza si observamos algunos estudios más. Por ejemplo, Basnight-Brown y Altarriba (2007; con *priming* enmascarado y no enmascarado) y Duñabeitia et al. (2010; con *priming* enmascarado), obtuvieron efectos de *priming* de traducción de la misma magnitud en ambas direcciones. En estos estudios los bilingües participantes eran muy competentes en sus dos lenguas en el primer caso, y totalmente equilibrados en el segundo con el añadido de haber aprendido sus dos lenguas simultáneamente, de manera que teniendo en cuenta el alto grado de competencia de los bilingües estudiados estos resultados estarían en consonancia con las predicciones del MJR y del MRD.

Finalmente, en esta misma línea cabe comentar un estudio más en relación a los efectos de *priming* de traducción observados en la literatura. Davis, Sánchez-Casas, García-Albea, Guasch, Molero y Ferré (2010; Experimento 1) estudiaron a cuatro grupos distintos de participantes: un grupo de españoles aprendices de inglés, un grupo de bilingües españoles competentes tardíos del inglés, un grupo de bilingües ingleses competentes tardíos de español y un grupo de bilingües equilibrados tempranos de español e inglés. De nuevo se empleó una tarea de decisión léxica con *priming* enmascarado de traducción en las direcciones L1-L2 y L2-L1. Además, se incluyó una condición de *priming* de repetición L1-L1 y otra L2-L2. La novedad de este estudio en relación a lo que estamos revisando aquí, es que las traducciones empleadas en el *priming* estaban divididas según si eran cognadas (i. e.: las dos palabras de la traducción son similares además de en el significado, también en la forma léxica) o no cognadas (i. e.: las dos palabras de la traducción son similares únicamente en el significado, de manera que la forma léxica difiere sustancialmente). En los resultados correspondientes a las traducciones cognadas, se observó que los tres grupos de bilingües más competentes mostraban efectos de *priming* de traducción de la misma magnitud en ambas direcciones y que dichos efectos no diferían significativamente del tamaño de los efectos de *priming* de repetición. En cambio, el grupo de aprendices solamente mostraba efectos en la dirección L1-L2. Mientras que para las traducciones no cognadas no se observó ningún tipo de efecto de *priming* para ninguno de los grupos de participantes, señalando que el estatus de cognado/no cognado es una variable importante a tener en cuenta a la hora de llevar a cabo estudios de *priming* enmascarado. No obstante, quedaría por investigar por qué el estatus de cognado/no cognado puede modular los efectos de *priming* (véase Sánchez-Casas, Lozano, Demestre, Ferré y Comesaña, 2011, para una investigación en este sentido).

Centrándonos ahora en los efectos de *priming* semántico, son numerosos los estudios que han empleado esta técnica para estudiar cómo los bilingües son capaces de acceder al nivel

conceptual desde la L2 (ej., Chen y Ng, 1989; de Groot y Hoeks, 1995; de Groot y Nas, 1991; Kroll y Borning, 1987; Schoonbaert et al., 2009). Si revisamos la literatura reciente, encontraremos evidencia de efectos de *priming* semántico a través de lenguas en la dirección de L1 a L2, tal y como sería de esperar según el MJR (ej., Basnight-Brown y Altarriba, 2007; Dong, Gui y Macwhinney, 2005; Kiran y Lebel, 2007; Perea, Duñabeitia y Carreiras, 2008). Pero si nos centramos en la dirección opuesta (de L2 a L1) los resultados no son tan consistentes. Por ejemplo, Basnight-Brown y Altarriba (2007; Experimento 1) encontraron efectos de *priming* semántico con bilingües tempranos de español (L1) e inglés (L2) con una tarea de decisión léxica en la dirección de L2 a L1, pero no en la dirección contraria. No obstante, el historial lingüístico de los participantes reveló que aunque por orden de adquisición la primera lengua hablada por los participantes era el español, en realidad por nivel de competencia la lengua dominante era el inglés, de manera que atendiendo a este nuevo orden y reetiquetando en consecuencia las dos lenguas de los participantes, sería la dirección de L2 a L1 la que no mostraría ningún efecto de *priming* semántico (véase Kiran y Lebel, 2007, para una situación lingüística similar). Recordemos además que en el mismo trabajo los autores también emplearon *priming* de traducción, donde sí hallaron efectos en ambas direcciones y de la misma magnitud.

Por otro lado, existen estudios que sí han obtenido efectos de *priming* semántico en la dirección de L2 a L1 (ej., Altarriba, 1992; Chen, y Ng, 1989; Frenck y Pynte, 1987; Jin, 1990; Keatley et al., 1994; Schoonbaert et al., 2009). Por ejemplo, en el artículo citado anteriormente de Silverberg y Samuel (2004) se examinó la dirección L2-L1 con bilingües competentes de español e inglés y una tarea de decisión léxica, hallando efectos de *priming* semántico significativos. Pero al estudiar solamente una dirección, no es posible comprobar si se dan efectos de asimetría. En cambio, estudios como el de Dong, et al. (2005) sí han explorado, también con la tarea de decisión léxica, los efectos de *priming* en ambas direcciones, en este caso con bilingües competentes de chino (L1) e inglés (L2). Los resultados mostraron efectos significativos de *priming* semántico en las dos direcciones, pero la comparación de los tamaños de los efectos reveló que éstos eran mayores en la dirección L1-L2 que en la dirección L2-L1.

Finalmente, existe un tercer patrón de resultados en relación a los efectos de *priming* semántico al explorar la dirección L2-L1 que es importante mencionar: la obtención de efectos de la misma magnitud que en la dirección L1-L2. Este es el caso del trabajo de Perea et al. (2008). Estos autores estudiaron a bilingües muy competentes de español y vasco y pusieron a prueba las dos direcciones de *priming* (i. e.: vasco-español y español-vasco). Para ello emplearon la tarea de decisión léxica y el paradigma de *priming* semántico enmascarado. Estos

autores encontraron efectos significativos tanto dentro como entre lenguas en las dos direcciones y, más importante, dichos efectos fueron de la misma magnitud independientemente de la dirección del *priming*.

Esta evidencia contrasta con la proporcionada por Basnight-Brown y Altarriba (2007; Experimento 2), donde con *priming* enmascarado no obtuvieron efectos de *priming* semántico en ninguna de las dos direcciones. Estos autores atribuyeron la ausencia de efectos de *priming* semántico a las estrictas condiciones de control experimental que llevaron a cabo (baja proporción de palabras relacionadas, presencia de máscara antes del *prime*, SOA [*Stimulus Onset Asynchrony]* de 100 ms, etc.) con el fin de eliminar cualquier factor estratégico y examinar únicamente los efectos de procesamiento automático. Ahora bien, en el mismo trabajo sí se obtuvo *priming* de traducción enmascarado en ambas direcciones, de manera que los autores concluyeron que en el caso del *priming* semántico, aunque probablemente se estuviera llevando a cabo un procesamiento semántico en los pares relacionados, la activación no fuera lo suficientemente fuerte como para provocar efectos de *priming* significativos.

Un último trabajo que cabe destacar es el de Schoonbaert et al. (2009) ya citado anteriormente al repasar la evidencia sobre el *priming* de traducción. Estos autores llevaron a cabo una tarea de decisión léxica con un paradigma de *priming* enmascarado, con participantes bilingües no equilibrados de holandés (L1) e inglés (L2). En este caso, cuando el SOA era corto (100 ms) se obtuvieron efectos de *priming* semántico de L2 a L1, pero no de L1 a L2, lo cual no es consistente con las predicciones de los modelos ni con la evidencia previa presente en la literatura. En cambio, con un SOA más largo (250 ms) se obtuvieron efectos simétricos de *priming* semántico a pesar de tratarse de bilingües no equilibrados. Cabe recordar que como hemos visto anteriormente en el mismo estudio se utilizó también el *priming* de traducción, y en ese caso sí se obtuvieron resultados asimétricos, siendo la dirección de L1 a L2 la que mostró efectos más fuertes.

A la vista de estos datos los distintos estudios parecen sugerir que los efectos de *priming* semántico simétricos sólo parecen emerger cuando se examina el rendimiento de bilingües equilibrados en las dos lenguas. Para proporcionar evidencia adicional sobre esta hipótesis, nos planteamos como objetivo de esta tesis estudiar el patrón de efectos de *priming* semántico en este tipo de bilingües. Asimismo, la mayoría de estudios que han empleado simultáneamente *priming* semántico y *priming* de traducción, muestran que los efectos de *priming* de traducción tienden a ser más fácilmente observables y de mayor magnitud que los efectos de *priming* semántico. De acuerdo con el MRD es fácil explicar este hecho, ya que según el modelo el número de rasgos preactivados por un *prime* que fuera la traducción del *target* sería

mucho mayor que en el caso de ser un *prime* relacionado semánticamente. En el apartado siguiente revisaremos la evidencia experimental que concuerda con esta idea de que cuanto más cercanos se hallan *prime* y *target* en términos semánticos, mayor activación se observa.

1.3.3.- Influencia del grado de relación semántica entre palabras en el uso de las conexiones léxicas y conceptuales en el bilingüe

En los apartados anteriores hemos examinado las propuestas acerca de cómo se desarrollan las conexiones entre el nivel léxico y el semántico/conceptual en el bilingüe, y los efectos de asimetría en el acceso al nivel semántico en función de la lengua desde la que se pretende acceder al nivel conceptual. Las variables que hemos tratado con mayor detalle (i. e.: nivel de competencia y edad de adquisición de la segunda lengua) se refieren a características de los participantes en relación a su L2. Pero existe también un extenso corpus de literatura que trata variables referentes a las características de los materiales, más que a las de los bilingües. Por ejemplo, se ha estudiado el estatus de cognado/no cognado entre palabras de distintas lenguas (ej.: Davis et al., 2010; de Groot y Nas, 1991; Gollan et al., 1997; Sánchez-Casas, Davis y García-Albea, 1992; Sánchez-Casas y García-Albea, 2005; Sánchez-Casas et al., 2011), los efectos diferenciales de las palabras concretas frente a las abstractas (ej.: de Groot, 1992b; de Groot, 1995; Schoonbaert et al., 2009; Tokowicz y Kroll, 2007; Tolentino y Tokowicz, 2009; van Hell y de Groot, 1998a) o cómo afectan al procesamiento semántico las diversas traducciones que una palabra en una lengua pueda tener en otra lengua (ej.: Boada, Sánchez-Casas, Gavilán y García-Albea, 2009; Degani y Tokowicz, 2010a, 2010b; Laxén y Lavaur, 2010; Sánchez-Casas, Suárez e Igoa, 1992; Tokowicz y Kroll, 2007).

Durante la revisión que hemos hecho de la literatura hemos mencionado otra variable referida a los materiales que tiene una gran importancia teórica para los dos modelos que nos están sirviendo de referencia en esta tesis: el grado de relación semántica entre palabras. Para centrarnos en esta variable, recordemos primero el experimento de Talamas et al. (1999). Estos autores estudiaron la interferencia que se producía en una tarea de reconocimiento de traducciones por el hecho de presentar pares de palabras relacionados semánticamente, en dos grupos de bilingües: más competentes y menos competentes en su segunda lengua. En los análisis *post hoc* de sus datos, los autores observaron que los bilingües competentes eran sensibles a la interferencia semántica independientemente de cuán parecidos fueran los estímulos entre sí, mientras que el grupo de bilingües menos competentes solamente mostraba interferencia semántica con los pares de palabras más semejantes entre sí. De la misma forma, Sunderman y Kroll (2006) también realizaron análisis *post hoc* de sus datos en un experimento

muy similar al anterior, observando que a mayor semejanza entre las palabras, mayor efecto de interferencia, aunque este hecho se daba independientemente del nivel de competencia de los bilingües.

Desde el MJR, la diferencia en los efectos de interferencia en función de la semejanza semántica puede explicarse si aceptamos que el uso de la ruta léxica o de la ruta conceptual en el bilingüe que trata de acceder al significado no debe entenderse en términos de todo o nada. Sería incorrecto pensar que los aprendices de una segunda lengua utilizan sistemáticamente la ruta léxica de traducción para, llegados a cierto punto de competencia en la L2, pasar a hacer un uso exclusivo de la ruta conceptual. Resulta teóricamente más aceptable suponer que ambas rutas se hallan activas simultáneamente, siendo la ruta léxica más rápida en los aprendices que la ruta conceptual. Por tanto, si al traducir una palabra se accede rápidamente a su traducción vía la ruta léxica, y no es necesario un procesamiento más profundo para la tarea en curso, es probable que pese a haberse iniciado un acceso conceptual de la traducción éste se aborte sin llegar a término. No obstante, esto no impide que, para determinadas palabras que se hallan muy cercanas en su significado sea probable que a pesar del escaso nivel de competencia del aprendiz en la L2, el acceso conceptual se realice con la suficiente velocidad como para dar lugar a los efectos de interferencia comentados anteriormente. Otra explicación a esta gradación de los efectos de interferencia en función del parecido semántico la podemos ofrecer desde el MRD. En este caso la explicación resulta más directa: las palabras más semejantes comparten un mayor número de nodos en el nivel semántico, y cuanto mayor sea el número de nodos compartidos por ambas palabras que se activen ante la presentación de la primera palabra, más difícil será decidir que la segunda palabra no es la traducción correcta de la primera, y por lo tanto mayor efecto de interferencia se observará.

Por lo tanto, parece claro que el grado de relación semántica juega algún papel en la manera en la que accedemos al nivel semántico, que es necesario explorar con mayor detalle. No obstante, la evidencia que aportan Talamas et al. (1999) y Sunderman y Kroll (2006) es fruto de análisis *a posteriori* de los datos, y no propiamente de manipulaciones experimentales. Además, hay discrepancias en sus resultados en cuanto en el trabajo de Talamas et al. (1999) se observa una interacción entre el grado de semejanza y el nivel de competencia de los bilingües, mientras que dicha interacción no se hace patente en el estudio de Sunderman y Kroll (2006).

Si bien no existen otros trabajos que hayan estudiado el efecto del grado de relación semántica entre palabras en bilingües, sí existen una serie de estudios en monolingües llevados a cabo con el paradigma de *priming* semántico. Estos trabajos sugieren que la magnitud

de los efectos de *priming* semántico puede depender del grado de relación semántica entre el *prime* y el *target* (McRae y Boisvert, 1998; Vigliocco, Vinson, Lewis y Garret, 2004).

Por ejemplo, McRae y Boisvert (1998; Experimento 3) emplearon una tarea de decisión semántica en la que los participantes debían decidir si la palabra *target* era concreta o no lo era. Sus materiales estaban formados por tripletes de palabras que incluían un *target* (ej.: *jar*; tarro), un *prime* muy similar en el significado (ej.: *bottle*; botella) y otro menos similar (ej.: *plate*; plato). La semejanza semántica entre dos palabras se definió en términos del número de rasgos semánticos compartidos por ambas y para la selección de materiales se basaron en el trabajo de McRae, de Sa y Seidenberg (1997) en el que se empleó una tarea de generación de rasgos. Posteriormente McRae y Boisvert realizaron una tarea de juicios de semejanza con un grupo de participantes independiente para asegurarse de que efectivamente los tripletes diferían en el significado. En todos los materiales se excluyó explícitamente a aquellos que tuvieran relación asociativa. McRae y Boisvert observaron que (cuando el SOA empleado era de 250 milisegundos) las palabras muy similares provocaban el efecto de *priming* semántico, mientras que las palabras menos similares no causaban efecto alguno.

Más recientemente, Vigliocco et al. (2004; Experimento 5) obtuvieron resultados parecidos, pero esta vez con la tarea de decisión léxica. En este caso, el parecido semántico se operativizó en términos del grado de solapamiento de rasgos semánticos entre palabras y para estimar dicho solapamiento, se empleó una tarea de generación de rasgos y se calcularon posteriormente las distancias semánticas entre *prime* y *target* en función del número de rasgos compartidos. Las condiciones de distancia semántica de los *primes* en relación al *target* (ej.: *dagger*; daga) fueron cuatro: muy cercana (ej.: *sword*; espada), cercana (ej.: *razor*; cuchilla), media (ej.: *hammer*; martillo) y lejana (ej.: *tongue*; lengua). Los resultados mostraron que la distancia semántica predecía adecuadamente los efectos de *priming* semántico, en el sentido de que a menor distancia semántica entre palabras, mayor era la magnitud de estos efectos.

Si asumimos que el número de nodos compartidos por las representaciones semánticas de dos palabras relacionadas es un indicador del solapamiento de sus significados (número de rasgos compartidos), entonces el MRD podría dar cuenta convenientemente de los efectos de *priming* semántico descritos en monolingües: las palabras muy cercanas en el significado compartirían un mayor número de nodos y como consecuencia mostrarían más efectos de *priming* que las intermedias o más lejanas semánticamente, que tendrían menos nodos en común.

En resumen, los datos observados en monolingües con el paradigma de *priming* semántico sugieren que el grado de relación semántica entre palabras influye en el tamaño de los efectos

de *priming* semántico, lo que significa que influye en la manera en la que se accede al nivel conceptual. Por tanto, resulta de gran interés para nuestros objetivos estudiar esta variable en bilingües. En el ámbito bilingüe las únicas referencias a esta variable son las que encontramos en los trabajos de Talamas et al. (1999) y Sunderman y Kroll (2006), pero la tarea que emplearon es la de reconocimiento de traducciones usando un paradigma de interferencia, y los análisis de los datos fueron realizados *a posteriori*. Además, ambos estudios difieren en cuanto a la interacción del grado de semejanza con el nivel de competencia de los bilingües. Por todo ello, el tercer objetivo de nuestro trabajo fue el de examinar el papel del grado de semejanza entre palabras de distinta lengua en dos aspectos: en la obtención de efectos de *priming* semántico en bilingües y en la tarea de reconocimiento de traducciones como manipulación experimental (a diferencia de los análisis *post hoc* presentes en la literatura). Con la evidencia previa de Talamas et al. (1999) y Sunderman y Kroll (2006) con reconocimiento de traducciones podríamos esperar que, con bilingües competentes, se observara la misma modulación que con monolingües. En este caso el MRD también podría dar cuenta de los resultados de la misma forma que en monolingües. Al proponer un nivel conceptual integrado en una red de nodos, la presentación de una palabra en una lengua activaría sus nodos correspondientes y éstos coincidirían en mayor o menor medida con la siguiente palabra, relacionada semánticamente con la primera, independientemente de la lengua de presentación.

1.4.- Resumen

El objetivo del presente trabajo es el de estudiar cómo se organiza la información acerca de las palabras en el bilingüe en cuanto a las conexiones que se establecen entre el nivel léxico y el semántico/conceptual de sus dos lenguas. Por ello hemos comenzado este apartado introductorio revisando los modelos que tratan de dar cuenta de la organización de la memoria del bilingüe, haciendo especial hincapié en el Modelo Jerárquico Revisado y en el Modelo de Rasgos Distribuidos, por ser las dos propuestas que aportan un marco teórico más adecuado para nuestros objetivos.

En concreto, el MJR hace una propuesta clara de cómo se desarrollan las conexiones léxicas y conceptuales en función del nivel de competencia del bilingüe: en las etapas iniciales de aprendizaje de una segunda lengua el bilingüe enfrentado a la tarea de traducir de la L2 a la L1 se basa principalmente en la ruta léxica de conexión entre las palabras de sus dos lenguas, mientras que una vez alcanzado un buen nivel de competencia, el bilingüe utilizaría principalmente sus conexiones directas entre la L2 y el nivel conceptual para realizar la misma tarea.

Por su parte, el MRD nos acerca un poco más a la comprensión no tanto de la organización, como de la representación dentro del nivel semántico/conceptual. La propuesta de un nivel conceptual formado por una red de nodos cuyo patrón de activación correspondería al significado del nodo de la forma en el nivel léxico, es tan simple como efectiva, ya que permite explicar los efectos de las relaciones entre palabras, así como aportar un punto de vista cuantitativo a la asimetría en la traducción predicha por el MJR. La diferencia no estaría tanto en el uso de una u otra ruta, sino en el número de nodos conceptuales en común entre una palabra de la L1 y la misma palabra en la L2, que sería mayor en el bilingüe competente y menor en el bilingüe principiante.

A continuación hemos revisado la literatura que pone a prueba la propuesta sobre el cambio en el uso de las rutas léxica y conceptual en el bilingüe en función de su nivel de competencia en la segunda lengua. Estudios como los de Talamas et al. (1999) y Sunderman y Kroll (2006) indican que los bilingües más avanzados en su segunda lengua tienen muy fortalecidas sus conexiones entre el nivel léxico de la L2 y el nivel conceptual, todo ello sin perder las conexiones entre ambos léxicos. Pero también indican que bajo ciertas circunstancias los bilingües menos competentes también podrían mostrar mediación conceptual. Aparte de estos estudios realizados con la tarea de reconocimiento de traducciones, hemos repasado además otra evidencia similar con distintas tareas como la de decisión semántica (ej., Dufour y Kroll, 1995) o el *priming* semántico (ej., Frenck-Mestre y Prince, 1997). A todo esto hemos añadido también la edad de adquisición de la segunda lengua. Hemos visto que en la literatura bilingüe existe evidencia que sugiere que, para obtener efectos de *priming* semántico y por lo tanto para disponer de la posibilidad de mediación conceptual, son necesarios tanto un buen nivel de competencia en la L2 como una edad de adquisición temprana (ej., Kotz, 2001 y Kotz y Elston-Güttler, 2004) mientras que otros trabajos únicamente contemplan como necesaria una temprana adquisición de la segunda lengua (ej., Silverberg y Samuel, 2004). Por todo ello nos planteamos estudiar aquí, por un lado, las propuestas del MJR y del MRD en cuanto al desarrollo de las conexiones léxicas y conceptuales en el bilingüe en función de su nivel de competencia en la L2 estableciendo una gradación del nivel de competencia en tres niveles. Por otro lado, quisimos ver el papel que juega la edad de adquisición de la segunda lengua en la posibilidad de mediación conceptual desde la L2, utilizando la tarea de reconocimiento de traducciones.

Hemos revisado también la evidencia a favor y en contra de la posibilidad de acceder al nivel conceptual directamente desde las dos lenguas del bilingüe, utilizando como indicio de dicho acceso la existencia de *priming* de traducción y semántico en función de la dirección. En cuanto al *priming* de traducción, hemos observado un patrón de resultados discrepante entre los distintos estudios (ej.: Dimitropoulou et al., 2011; Duyck y Warlop, 2009; Schoonbaert et al., 2009), pero que cobra sentido en cuanto atendemos a las diferencias relativas al nivel de competencia/edad de adquisición de los participantes. En cuanto al *priming* semántico, en la dirección de L1 a L2 parece claro que es posible encontrar efectos de *priming* semántico (ej.: Basnight-Brown y Altarriba, 2007; Dong, et al., 2005; Kiran y Lebel, 2007; Perea, et al., 2008). Pero al centrarnos en la dirección de L2 a L1 hemos comprobado que algunos trabajos no encontraron efectos significativos de *priming* semántico (Basnight-Brown y Altarriba, 2007) mientras que otros sí los observaron (ej., Altarriba, 1992; Chen, y Ng, 1989; Frenck y Pynte, 1987; Jin, 1990; Keatley et al., 1994). No obstante, los efectos encontrados en

esta dirección fueron en algunos casos de menor magnitud a los encontrados de L1 a L2 (Dong, et al., 2005) y otras veces fueron de la misma magnitud (Perea, et al., 2008). E incluso en otro caso (Schoonbaert et al., 2009) los efectos fueron muy parecidos en ambas direcciones experimentales, pero al realizar lo mismo con una tarea de *priming* de traducción se hizo patente la asimetría en la traducción que predeciría el MJR. Como los resultados de los distintos estudios parecen señalar que es necesario un alto nivel de competencia en la L2 para obtener efectos de *priming* simétrico en bilingües, quisimos comprobarlo experimentalmente, añadiendo además una última variable referente a los materiales: el grado de relación semántica entre palabras.

En cuanto a esta última variable, hemos visto que tanto MCRae y Boisvert (1998) como Vigliocco et al. (2004), en estudios con monolingües demostraron que la magnitud de los efectos de *priming* semántico estaba directamente relacionada con el parecido semántico de las palabras. En el ámbito bilingüe, las evidencias disponibles en la misma línea (i. e.: Sunderman y Kroll, 2006; Talamas et al., 1999) se obtuvieron en análisis *post hoc* de los datos, de manera que quedaría pendiente realizar un análisis controlado de esta variable en bilingües.

En el siguiente capítulo se presentará la parte experimental de esta tesis, compuesta por cuatro artículos de investigación que tratan de abordar los objetivos que se han ido desgranando a lo largo de esta introducción. Posteriormente, en el capítulo de discusión, veremos cómo explicar los resultados experimentales obtenidos desde el marco teórico del MJR y del MRD, y cómo se integran estos resultados con la literatura previa aquí revisada.

II.- TRABAJO EXPERIMENTAL

2.1.- Presentación de los artículos

El trabajo experimental de esta tesis se concentró en los cuatro artículos de investigación que se presentan a continuación. Todos ellos comparten en cierta medida los mismos materiales experimentales y parte de la metodología, que se basa en el paradigma de *priming* semántico en dos casos, y en el paradigma de interferencia en otros dos. Asimismo, todos ellos comparten un hilo conductor común: el interés por avanzar en el estudio del proceso de adquisición de las palabras en la L2.

El primer artículo sirvió para poner una primera piedra para el abordaje en bilingües del tema del grado de relación semántica entre lenguas. En concreto, partiendo de los resultados experimentales y de la metodología empleada por Vigliocco, et al. (2004) y McRae y Boisvert (1998) con monolingües, se emplearon dos tareas distintas para determinar el grado de semejanza/distancia semántica entre palabras del castellano. Con estas medidas se seleccionó un conjunto de materiales que nos permitió examinar la relación entre el grado de similitud semántica entre *prime* y *target* y la magnitud de los efectos de *priming* semántico, por primera vez en castellano. Estos materiales fueron puestos a prueba con dos tareas distintas: una tarea de decisión léxica, habitualmente empleada en este tipo de estudios y otra de decisión semántica, menos utilizada, pero que requiere un mayor procesamiento del significado para ser llevada a cabo (Frenck-Mestre y Bueno, 1999; McRae y Boisvert, 1998).

En el segundo artículo se puso a prueba la propuesta del Modelo Jerárquico Revisado (Kroll & Stewart, 1994) sobre el desarrollo de las conexiones léxicas y conceptuales de las dos lenguas de los bilingües, utilizando un grupo de bilingües tempranos de castellano-catalán (muy competentes en ambas lenguas) y un grupo de castellanos aprendices de catalán. Como en el estudio de Talamas et al. (1999), empleamos una tarea de reconocimiento de traducciones con falsas traducciones relacionadas en la forma y otras relacionadas en el significado. Adicionalmente, exploramos experimentalmente la propuesta observada en los análisis *post hoc* de los estudios de Talamas et al. (1999) y Sunderman y Kroll (2006), referente a que el

grado de relación semántica entre traducciones puede afectar al rendimiento de los bilingües. Para ello, se emplearon dos condiciones de relación semántica (muy cercana y cercana) formadas por la versión bilingüe de los materiales utilizados en los experimentos descritos en el artículo anterior. Finalmente, se evaluó también la relevancia de la edad de adquisición de la segunda lengua frente a la relevancia del nivel de competencia, incluyendo en el estudio a un tercer grupo de participantes castellanos muy competentes en su segunda lengua (catalán), pero que la aprendieron en una etapa tardía de su vida.

El tercer artículo profundizó en el estudio del nivel de competencia de la segunda lengua como variable relevante en el establecimiento de las conexiones léxicas y conceptuales en la memoria bilingüe, estudiando una gradación de tres grupos de bilingües con distinto nivel de competencia en la L2. De nuevo, los materiales utilizados fueron los previamente usados en los estudios anteriores, y las condiciones de relación semántica tuvieron los dos niveles empleados en los anteriores experimentos. Se incluyó también una condición de relación formal. Los resultados de este estudio nos permitieron observar de una forma más precisa la manera en que los bilingües pasan de depender de sus conexiones léxicas entre lenguas, a poder acceder directamente al nivel conceptual desde su segunda lengua además de, de nuevo, estudiar el papel del grado de relación semántica entre palabras en el rendimiento de los bilingües en la tarea de reconocimiento de traducciones.

Finalmente, de forma similar al primer artículo, en el cuarto artículo se estudió de nuevo el rol que desempeña el grado de solapamiento semántico entre palabras en los efectos de *priming* semántico, pero esta vez se hizo a través de lenguas con bilingües altamente competentes tanto en la L1 como en la L2. De esta manera, además de estudiar cómo influye el solapamiento semántico en el patrón de efectos de *priming* semántico por primera vez en bilingües, se pudo estudiar también si los efectos de *priming* de traducción y de *priming* semántico son asimétricos en cuanto a la magnitud de los efectos en función de la dirección, en este tipo de bilingües.

ARTÍCULO I

Sánchez-Casas, R., Ferré, P., García-Albea, J. E. y Guasch, M.

The nature of semantic priming: Effects of the degree of semantic similarity between primes and targets in Spanish

European Journal of Cognitive Psychology, 18, 161–184
(2006)

Artículo 1

Sánchez-Casas, R., Ferré, P., García-Albea, J. E. y Guasch, M. (2006). The nature of semantic priming: Effects of the degree of semantic similarity between primes and targets in Spanish. *European Journal of Cognitive Psychology, 18*, 161–184.

Objetivos específicos

- Examinar en monolingües hablantes del castellano los efectos del grado de semejanza semántica entre palabras con el paradigma de *priming* semántico no enmascarado, utilizando dos tareas distintas.

- Obtener un conjunto de materiales adecuado para el estudio de las relaciones puramente semánticas entre palabras con dos niveles distintos de semejanza.

Predicciones

En base a la evidencia previa de McRae y Boisvert (1998) y Vigliocco et al. (2004), esperaríamos observar efectos de *priming* semántico significativos en ambas tareas. Además, se esperaría observar también algún tipo de modulación de los efectos de *priming* en base al parecido en el significado de las palabras, en el sentido de que o bien hubiera efectos de mayor magnitud en la condición muy cercana que en la condición cercana (ej., Vigliocco et al., 2004), o bien solamente hubiera efectos en la condición de relación muy cercana (ej., McRae y Boisvert, 1998).

Resumen

En el artículo que se presenta a continuación, se estudiaron los efectos de *priming* semántico entre palabras relacionadas semánticamente en mayor o menor grado, en castellano. El grado de semejanza en el significado estaba definido en términos de solapamiento de rasgos semánticos entre palabras.

Con este objetivo se elaboró un conjunto de materiales formado por tripletes de palabras: dos palabras con función de *prime* y una con función de *target*. La primera palabra *prime* tenía una relación muy cercana con el *target*, mientras que la segunda era cercana pero en menor medida. Por ejemplo, el *target* 'burro' podía aparecer con la palabra 'caballo', muy cercana semánticamente, o con la palabra 'oso', no tan próxima en significado. Para comprobar la adecuación de los materiales a las dos condiciones de relación (muy cercana y cercana) se emplearon dos tareas: una de juicios de semejanza y otra de generación de rasgos, con el cálculo posterior de la distancia semántica entre palabras. Además, se comprobó que en ningún caso los dos *primes* y su respectivo *target* fueran asociados léxicos.

Una vez seleccionados, se emplearon estos materiales para explorar el patrón de efectos de *priming* semántico con ambos tipos de relaciones. Para ello se utilizó una tarea de decisión léxica por ser la que se usa más habitualmente en este tipo de estudios, permitiendo por tanto la comparación de los resultados con la literatura previa, y otra de decisión semántica, apropiada para este caso por ser una tarea cuya naturaleza es esencialmente semántica.

Los dos instrumentos diseñados para la selección de materiales permitieron elegir 72 tripletes de palabras, cuyas dos medidas independientes de parecido semántico (juicios de semejanza y distancia semántica) correlacionaron significativamente. Los resultados de las dos tareas experimentales con dichos materiales mostraron efectos de *priming* significativos en ambas condiciones de relación semántica (muy cercana y cercana). Además, en las dos tareas empleadas la magnitud de los efectos de *priming* fue mayor en la condición de relación muy cercana que en la condición de relación cercana, siendo esta diferencia en magnitudes significativa en la tarea de decisión léxica. Estos resultados demuestran que los efectos de *priming* semántico son sensibles al grado de parecido en el significado de las palabras.

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The nature of semantic priming: Effects of the degree of semantic similarity between primes and targets in Spanish

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Semantic priming has been a widely used paradigm in research about semantic memory. In this study we tested the effects of the degree of semantic similarity between primes and targets (defined in terms of shared features) in semantic priming. We selected pairs of semantically related words to be used as primes and targets by using a similarity rating task and a feature generation task. Through these two tasks we obtained prime–target pairs that were more or less related in meaning (very close and close pairs). We tested these pairs in a lexical decision task (Experiment 1) and in a semantic decision task (Experiment 2). In both experiments, we obtained evidence of automatic semantic priming in both the very close and the close semantic conditions. Furthermore, in both tasks we found that priming was higher for very close than close semantic words. On the basis of these findings, we can conclude that the amount of automatic semantic priming appears to depend on the degree of semantic similarity between primes and targets.

The most widely used experimental paradigm in research about the organisation of semantic memory has been semantic priming (see Neely, 1991, for a review). In semantic priming, a target word is responded to more quickly after a related prime word has been presented (e.g., doctor–NURSE) than after the presentation of an unrelated prime (e.g., carpet–NURSE). In spite of its widespread use, not all the findings from semantic priming studies can be considered to reveal the characteristics of semantic organisation. Only those studies in which automatic priming effects have been found are thought to be relevant (Lucas, 2000;

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Thompson-Schill, Kurtz, & Gabrieli, 1998). Priming is interpreted to be automatic if it is not influenced by strategies. The issue of whether automatic priming can be obtained with semantically related words that are not associates has raised considerable controversy. Associative relatedness is assumed to reflect word use rather than word meaning (Thompson-Schill et al., 1998), since it is defined in terms of temporal contiguity in speech or text (Plaut, 1995) or word cooccurrence within a proposition (McNamara, 1992). Thus, a prime and a target are associatively related when a large percentage of people give the target when they are instructed to produce the first word that comes to their minds in response to the prime. Conversely, semantic relationships are not as clearly defined as associative ones. In a wide sense, semantic relatedness refers to any relation between two words that is based on their meaning and not simply on their usage (Thompson-Schill et al., 1998). For instance, primes and targets can be considered to be semantically related if they are members of the same category (e.g., Chiarello, Burgess, Richards, & Pollock, 1990; Frenck-Mestre & Bueno, 1999; Lupker, 1984; Neely, Keefe, & Ross, 1989; Perea & Rosa, 2002; Thompson-Schill et al., 1998), or synonyms (e.g., Bueno & Frenck-Mestre, 2002; Perea & Rosa, 2002), or if they have a functional relation (e.g., hammer–nail; Moss, Ostrin, Tyler, & Marslen-Wilson, 1995; Thompson-Schill et al., 1998) or a part–whole relation (e.g., stem–flower; Thompson-Schill et al., 1998).

In the earliest studies, the associative values of the semantically related prime–target pairs were not controlled, so the primes could be semantically as well as associatively related (Meyer & Schvaneveldt, 1971; Meyer, Schvaneveldt, & Ruddy, 1975). Given the confounding of these two relations, it is difficult to determine from these initial studies if the reported priming effects were actually semantic or associative. In order to overcome this problem, subsequent studies attempted to dissociate these two kinds of relations, by using prime and targets that were only semantically related. The results of these priming studies, however, were inconclusive. While some authors found evidence of purely automatic semantic priming (i.e., in the absence of association), (Chiarello et al., 1990; Fischler, 1977; Hodgson, 1991), others failed to do so (Lupker, 1984; Moss et al., 1995; Shelton & Martin, 1992).

This conflicting evidence regarding the pattern of semantic priming effects led to the conclusion that purely automatic semantic priming was not a reliable phenomenon. Furthermore, at that time, this evidence also constituted a serious challenge to distributed models of memory (e.g., McRae, Seidenberg, & de Sa, 1997; Plaut, 1995). According to these models, word meaning is represented by a pattern of activation over a large number of units representing features or microfeatures. Related words are those that share a set of semantic features and are encoded as overlapping patterns of activation. Within memory distributed models, semantic priming effects are thought to be the result of the similarity between the activation patterns produced by primes and targets. Thus, the failure

to find a reliable priming effect when primes and targets were semantically related clearly questioned the semantic organisation proposed by this type of model, as well as assumptions about word meaning representation in terms of features.

However, before definitive conclusions about the validity of models of semantic organisation were drawn, more recent studies considered that it was necessary to determine the conditions under which priming could be purely automatic (Lucas, 2000; McRae & Boisvert, 1998). These studies have showed that the methods used in previous priming experiments differed in several respects. The most relevant ones here are the procedure they employed and how they selected the related prime–target pairs. As far as the procedure is concerned, it was found that the studies that failed to obtain conclusive evidence of semantic priming used different SOAs (i.e., stimulus onset asynchrony: the time between the onset of the prime and that of the target). They also used different proportions of related pairs in the experimental set, and the task that participants were instructed to perform was not always the same in all the experiments. Why are these factors important? The main reason is that they may favour, to one extent or another, the use of processing strategies that are the result of controlled processes and which do not necessarily reflect characteristics of semantic organisation (Thompson-Schill et al., 1998). First, we shall analyse what these strategies are and what the pattern of results is when their influence is reduced. Second, we shall discuss in greater detail the issues related to stimulus selection since this will be one of the issues addressed in the present study.

There are two main types of strategies that participants can use in priming tasks: retrospective processing (Neely et al., 1989) and prospective expectancy generation (Becker, 1980). Retrospective processing occurs when participants evaluate the relationship between the prime and the target after the target has been presented and before the participants respond. In this case, participants can use any relationship they detect between the prime and the target as a cue to respond ‘‘yes’’ (e.g., in a lexical decision task, in which participants have to decide whether the target is or is not a word). Prospective expectancy generation takes place when participants notice that some prime–target pairs are related and so generate possible related targets in every trial the prime is presented. Thus, on some of the related trials (but on none of the unrelated ones), participants can eventually generate the correct target, and, as a consequence, priming effects might be overestimated. Therefore, retrospective processing and prospective expectancy generation refer to controlled processes that do not necessarily reflect characteristics of semantic organisation (Thompson-Schill et al., 1998).

Participants’ possible strategies can be controlled by a variety of methods. On the one hand, prospective expectancy generation can be reduced by using intervals between the onset of the prime and the target (SOAs) of 250 ms or less, since this time is too short to allow participants to generate expectancies (Neely, 1977). Another way of discouraging participants from using this strat-

egy is to include a low proportion of related pairs (no more than 25%) within the stimulus set (Chiarello et al., 1990). On the other hand, both prospective and retrospective processing can be minimised by using the continuous priming technique. In this technique, participants are asked to respond to every item, and it is less likely that they can detect the relationship between primes and targets (Shelton & Martin, 1992). Another way of decreasing retrospective processing is to use a semantic decision task (e.g., a task in which participants have to decide whether targets are concrete nouns or not; McRae et al., 1997). In this sort of task, related prime–target pairs that require a ''no'' response (e.g., aggression–violence) can be included in the stimulus set, preventing participants from using their detection of a relationship between prime and target as a cue to respond ''yes''.

None of these measures were adopted systematically by the early studies that reported semantic priming effects in the absence of association (Chiarello et al., 1990; Fischler, 1977; Hodgson, 1991) so those effects might have been the result of strategic processes rather than automatic ones. Thus, it is critical to determine what happens when strategic influences are minimised. For instance, some studies have found evidence of purely semantic priming with SOAs of 250 ms or less (Bueno & Frenck-Mestre, 2002; Frenck-Mestre & Bueno, 1999; McRae & Boisvert, 1998; Perea & Rosa, 2002; Vigliocco, Vinson, Lewis, & Garrett, 2004; see also Lucas, 2000, for a review). Semantic priming effects are also obtained when the experimental materials include a low proportion of related words (McRae & Boisvert, 1998; McRae et al., 1997; Perea & Rosa, 2002; see Lucas, 2000, for a review), and when the continuous priming technique is used (McRae & Boisvert, 1998; Perea & Rosa, 2002; see also Lucas, 2000, for a review). These findings clearly suggest that semantic priming with nonassociated words does not occur solely in conditions that favour strategic processing, but it seems to be a phenomenon that taps automatic processes.

The results concerning the tasks that the studies have used are not conclusive. Many semantic priming studies have used a lexical decision task (e.g., McRae & Boisvert, 1998; McRae et al., 1997; Perea & Rosa, 2002; Thompson-Schill et al., 1998; Vigliocco et al., 2004). However, some authors have failed to report semantic priming effects with this task. They have suggested that it is important to use other tasks, such as semantic decision, that require the use of semantic information, and which therefore may be more sensitive to semantic processing (Bueno & Frenck-Mestre, 2002; Frenck-Mestre & Bueno, 1999; Grainger & Frenck-Mestre, 1998). As mentioned above, a semantic decision task also enables the retrospective processing strategy to be controlled. Other authors, however, consider that lexical decision is a suitable task because it is less likely to be influenced by strategic factors (e.g., Lucas, 2000). Moreover, recent data have demonstrated that lexical decision tasks are sensitive not only to semantic information, but also to different degrees of semantic similarity (Vigliocco et al., 2004).

The second issue that is relevant to the study of semantic priming and that has been investigated only recently (e.g., McRae et al., 1997; Vigliocco et al., 2004) is that of the selection of the related prime–target pairs. The first question to consider is the type of semantic relations that have been tested. Although most studies have used category coordinates as prime–target pairs (e.g., Chiarello et al., 1990; Frenck-Mestre & Bueno, 1999; Lupker, 1984; Neely et al., 1989; Perea & Rosa, 2002; Thompson-Schill et al., 1998; see also Lucas, 2000), other semantic relationships have also been investigated. These include synonyms, antonyms, script relations, functional relations, and part–whole relations. The results of a meta-analysis conducted by Lucas (2000) have shown that these types of semantic relations have different effects on the magnitude of semantic priming produced.

A second important question concerning stimulus selection has to do with the degree of semantic similarity itself. The studies neither agree on the strength of the semantic relationship between primes and targets, nor used the same procedures to assess their semantic similarity. Unlike association norms that are derived from a standard task, there is no homogeneity in the tasks used to assess the degree of semantic similarity between words (Lucas, 2000). Some studies have used similarity rating tasks in which participants have to rate the similarity between primes and targets on a scale (e.g., Moss et al., 1995; Perea & Rosa, 2002), while others have based their selection of semantically related pairs on their own intuitions. This is the case for some of the initial studies that failed to find purely semantic priming effects such as that of Shelton and Martin (1992). When other authors made participants perform a similarity rating task with Shelton and Martin's materials, they found that primes and targets were actually not very similar (McRae & Boisvert, 1998). Clearly it is necessary to reach a consensus regarding the method to be used to select semantically related pairs, so that the results from different studies can be compared.

In recent years, several important steps have been taken in order to obtain a corpus of semantic relationships between words based on normative data. In particular, two databases of semantic features of English words have been published (McRae et al., 1997; Vinson & Vigliocco, 2002). The usual procedure in these studies has been to ask participants to list the semantic features of a set of words (i.e., a feature generation task), and then to obtain description of every word meaning in terms of the features that define it. This description is based on the features provided and also on the proportion of participants who provide the same feature for any given word.

Such databases make it possible to select prime–target word pairs in a more rigorous and systematic way, according to their degree of semantic overlap or semantic similarity. Several studies have used these databases and they have shown that there is automatic purely semantic priming when similarity in meaning is defined in terms of shared features (e.g., McRae & Boisvert, 1998; McRae et al., 1997; Vigliocco et al., 2004). Moreover, the magnitude of the

semantic priming effect seems to depend on the degree of semantic similarity between the prime and the target (e.g., Vigliocco et al., 2004). These findings are of great relevance for distributed models of semantic memory since, as mentioned above, these models propose that priming directly depends on the featural overlap between primes and targets.

The main purpose of the present work was to test the effects of the degree of semantic similarity between primes and targets in a semantic priming paradigm, when similarity is defined in terms of shared features. In order to achieve this aim, we selected pairs of semantically related words and tested them in a similarity-rating task. Furthermore, to our knowledge, there are no normative data in Spanish regarding the semantic features of words, so we used a feature generation task similar to that used by McRae et al. (1997) and Vigliocco et al. (2004) to obtain a set of features for the meaning of our word pairs. Finally, we tested these pairs of words in two priming experiments. In Experiment 1, we used a lexical decision task and, in Experiment 2, a semantic decision task.

SELECTION OF SEMANTICALLY RELATED WORDS

As stated above, studies on semantic memory have used various ways of ensuring that the words in their experimental materials are semantically related. A common strategy has been to use a similarity rating task (e.g., Moss et al., 1995; Perea & Rosa, 2002; Puerta-Melguizo, Bajo, & Gómez-Ariza, 1998). In this task, participants are asked to rate the similarity in meaning of word pairs on a given scale and their rate estimates are used as an index of semantic similarity. A second more recent strategy for establishing semantic relations has been to use a feature generation task (McRae & Boisvert, 1998; McRae et al., 1997; Vigliocco et al., 2004; Vinson & Vigliocco, 2002). As mentioned above, this task consists of asking people to list features of the meaning of a set of words and then computing the semantic distance between them. In order to select the semantically related words to be used in Experiments 1 and 2 of this study, we used both the rating similarity and the feature generation tasks. This allowed us, on the one hand, to select the set of related word pairs more reliably, since selection was based on different measures of semantic similarity; and, on the other hand, to determine to what extent both measures are correlated. First, we will report the data from the similarity rating task and, second, the data from the feature generation task

Semantic similarity rating task

A set of 80 Spanish words belonging to different semantic categories was initially selected. The categories were: mammals, insects, birds, fish, reptiles, fruit, vegetables, articles of furniture, meals and beverages, parts of the body, articles of clothing, kitchen utensils, tools, trees, vehicles, spices, weather phenomena, toys, weapons, and parts of a building. Each word in the set was

paired with two words that were semantically related. These two words were coordinates of the same category as the word from the initial set, but one was more similar in meaning than the other (here after these words will be referred to as very close and close words, respectively). For example, the word *burro* (donkey) was paired with *caballo* (horse) and *oso* (bear). In this example, horse is considered to be more similar in meaning to donkey than bear. The degree of semantic similarity between the words (i.e., being more or less similar in meaning) was initially established by the authors, based on their own intuitions.

In order to ensure that our semantically related word pairs were not also associates, we first carried out a free association task with all the selected words. The words were grouped in three different lists: List 1 contained the 80 words from the initial set; list 2 included the very close words; and list 3, the close words. Seventy first-year Psychology students from the Rovira i Virgili University, Tarragona, were asked to perform the task. Twenty-four participants received the first list, twenty-one the second list, and twenty-five the third list. They were instructed to write, for each word in the list, the first word that came to their minds, and they were given as much time as they needed. Once the participants had completed the task, their responses were examined to exclude possible associates within the word pairs selected. In particular, a very close word or a close word was excluded from the stimulus set if more than three participants produced it as an associate of the corresponding word from the initial set (e.g., if they gave the words *caballo* or *oso* as an associate of word *burro*); or if the latter was given as an associate of the very close or the close words (e.g., to give the word *burro* when asked for associates of the words *caballo* or *oso*). Applying these criteria, 8 word triplets were excluded from the initial set, leaving us with a final set of 72 word triplets that were only semantically related. From now on, we will refer to the words with which very close words and close words are related, as target words.[1]

The similarity rating task was performed on the final set of materials by a group of 34 first-year Psychology students who had not participated in the free association task. Two lists were constructed, containing 108 word pairs each: 36 pairs where the target word was paired with a very close word, 36 pairs in which the target word was paired with a close word, and, finally, 36 unrelated word pairs that were included as filler items. The target words that were paired with very close words in list 1 (*burro–caballo*) were presented with close words in list 2 (*burro–oso*), and vice versa.

The two lists were distributed during a class session. Participants were instructed to rate the similarity of the things to which the two words referred, on a scale from 1 (not all similar) to 9 (exactly the same thing). Nineteen

[1] We will refer to these words as target words because they will be used as targets in the two priming experiments

participants made similarity judgements for list 1 and fifteen participants for list 2. Examples were provided in both cases. Participants were given as much time as they needed to perform the task.

A mean value was computed for each of the word pairs by averaging the similarity ratings of all the participants who had rated the pair. Table 1 shows the means of the similarity ratings of the *target* and the two semantically related words (very close and close words). Comparing the two corresponding means revealed that participants rated very close words (e.g., *caballo*) as significantly more similar in meaning to the target word (e.g., *burro*) than close words (*oso*), $t(71) = 16.2$, $p < .0001$. In addition, very close and close words were judged to be semantically more similar than their controls, $t(71) = 45.19$, $p < .0001$, and $t(71) = 21.9$, $p < .0001$, for very close and close words, respectively.

On the basis of these results, we can conclude, on the one hand, that the related word pairs included in our stimulus set are only semantically related (i.e., they are not associates); and, on the other hand, that people's judgements show that they differ in their degree of semantic similarity. The data obtained in the feature generation task provide further evidence to support this difference.

Feature generation task

The feature generation task provides a measure of the degree of semantic similarity between related words taking into account the number of features the words meanings share (e.g., McRae & Boisvert, 1998; McRae et al., 1997; Vigliocco et al., 2004; Vinson & Vigliocco, 2002). Following the procedure of previous studies, we asked an additional sample of 70 first-year psychology students from the Rovira i Virgili University to perform this task with the same word set as the one used in the similarity rating task. Participants were asked to list features of the things to which the words referred to. They were told that they could list different types of features, such as perceptual properties (e.g., how it looks, sounds, smells, feels and tastes), functional properties (e.g., what it is used for, where and when it is used), and other things they knew about each concept. Two examples were provided for each type. Words were grouped in three lists. Thirty-one participants listed features for the words included in list 1 (target

TABLE 1
Means (and standard errors of the mean) of semantic distances and similarity ratings between target words and words in very close and close semantic conditions

	Very close	*Close*
Similarity ratings	6.19 (0.82)	4.07 (0.71)
Semantic distances	0.73 (0.21)	1.03 (0.15)

words), twenty-one listed features for words from list 2 (very close words), and twenty-five performed the task with list 3 (close words), so that a given participant only produced features for one of the members of each triplet. Participants were given their list in a class session and were given as much time as they needed to perform the task.

All the semantic features listed for each word were recorded separately by the first three authors, following exactly the same recording procedure. Each of them recorded the semantic features of one of the words on the list, together with the number of participants that mentioned each of the features. Care was taken to record synonymous features identically (e.g., it is a mixture of sand and water and it is a mixture of soil and water) and to record features differing even only slightly in meaning separately (e.g., it needs water and it needs lot of water). When participants produced conjoint features (e.g., ''has four legs'' or ''it is grey or brown'' for the word ''donkey''), they were counted as two separate features (e.g., ''has legs'' and ''has four legs''; or ''it is grey'' and ''it is brown''). A feature was considered to be part of a word's meaning if that feature was listed by at least 16% of the participants. Each of the three authors who recorded the words' features corroborated their recordings with the remaining two authors. In total, we obtained a list of features of the meaning of 216 words.

Once the recording had been completed, a correspondence analysis between the three words in every triplet (target words, very close words, and close words) was performed. The analysis took into account the semantic features shared between any two members of the triplet, as well as the number of participants who had listed any semantic feature for any given word. Based on the results of the correspondence analysis, we obtained a spatial representation for each triplet, including target, very close words, and close words. Euclidean distances were then computed between target words and very close words and between the targets and close words (see Appendix A for a more detailed explanation of this procedure).

Table 1 shows the semantic distances between the targets and each of the semantically related words (very close and close words). The analyses showed that very close words were less distant to the target words than close words, $t(71) = -12.93$, $p < .0001$. These results confirm those obtained with the similarity rating task, providing further evidence of the difference in meaning similarity of our semantically related word pairs.

Given that the pattern of results was the same with the similarity rating and the feature generation tasks, we finally calculated the correlation of the measures provided by the two tasks. Like McRae et al. (1997), we found the correlation to be significant, $r = -0.59$, $p < .001$; that is, the greater the rating of similarity between two words, the smaller the semantic distance between them. This finding supports the validity of the two measures as an index of semantic similarity, and it appears to be consistent with the view that semantic feature overlap might be one of the factors that underlie similarity ratings.

Based on the results reported up to now, we considered that the two semantic relations we established were clearly distinct in terms of their degree of meaning similarity. Our next aim was to examine the pattern of semantic priming effects with both relations. To our knowledge two priming studies have explored the effects of degree of semantic similarity. One of these studies was carried out by McRae and Boisvert (1998). The authors used a semantic decision task, where participants were asked to decide whether or not the target word was a concrete noun, and they defined semantic similarity between prime and target in terms of the number of semantic features the two words shared. The results of this study showed that, when a SOA of 250 is used, semantic priming effects varied with the degree of semantic similarity, and that these effects were significant when the similarity between the meaning of the prime and target words was high, but not when it was low. More recently, Vigliocco et al. (2004) obtained a similar pattern of results when they used a lexical decision task. In particular, they calculated the semantic distance between prime and target pairs, and defined similarity in meaning in terms of semantic feature overlap. They observed that measures of semantic distance between primes and targets predicted the magnitude of the semantic priming effects. Following these studies, we investigated the effects of our very close and close semantic relations in two semantic priming experiments. In Experiment 1 we used, as did Vigliocco et al., a lexical decision task, in which participants were asked to decide whether the target is a word or not. Lexical decision is the most commonly used task in studies on semantic priming. Although some studies have failed to obtain significant semantic priming effects with lexical decision (Lucas, 2000), other studies have shown these effects, and some recent studies have even found this task to be sensitive to degree of semantic similarity (Vigliocco et al., 2004). Thus, if we use lexical decision, our findings can be compared with those previously reported in the literature.

In Experiment 2, we used a semantic decision task similar to the one used by McRae and Boisvert (1998), in which participants have to decide whether the target is a concrete or an abstract noun. This type of task is clearly semantic in nature, since participants have to rely on semantic knowledge to give their response, and it has been considered more suitable for studying automatic semantic priming than lexical decision (see Bueno & Frenck-Mestre, 2002; Frenck-Mestre & Bueno, 1999; Grainger & Frenck-Mestre, 1998). Therefore, it seems appropriate to use a semantic decision task. Nevertheless, it should be mentioned that other authors have argued that this task is more likely to be influenced by strategic factors than lexical decision (Lucas, 2000).

In order to ensure that semantic priming is purely automatic and not due to the influence of strategic processing, both Experiments 1 and 2 used a short SOA and a low proportion of prime–target related pairs. In particular, we used a SOA of 250 ms and a proportion of 25% of related prime–target pairs that have been shown to discourage participants from using the so-called prospective

expectancy generation strategy (e.g., McRae & Boivert, 1998; Posner & Snyder, 1975). In the case of the semantic decision experiment (i.e., Experiment 2), the use of a retrospective processing strategy was controlled by manipulating the characteristics of the filler words.

EXPERIMENT 1

Method

Participants. Sixty first-year Psychology students from Rovira i Virgili University, Tarragona, participated in the experiment as part of the course requirement. All of them had either normal or corrected vision.

Materials and design. The experimental word set consisted of the 72 word triplets selected from the similarity and feature generation task (see Appendix B). Each triplet contained a *target* word, and two semantically related words (a very close word and a close word). The 72 target words could be presented under any one of four priming conditions: (a) an *identity condition*, where the target word was preceded by itself (e.g., *burro–BURRO*, donkey–DONKEY); (b) a *very close semantic condition*, where the target was preceded by a very closely semantically related word (e.g., *caballo–BURRO*, horse–DONKEY); (c) a *close semantic condition*, in which the word presented as a prime was less semantically related to the target word (e.g., *oso–BURRO*, bear–DONKEY); and finally (d) a *control condition* where the prime word was not related in meaning to the target word. The unrelated primes were selected from a semantic category other than that of the target (e.g., *dedal–BURRO*, thimble–DONKEY). All experimental prime–target pairs were concrete nouns. In addition to the experimental prime–target pairs, 72 filler prime–target pairs were included so that the proportion of related items was low (i.e., 19%). One hundred and forty-four nonwords were also constructed to be presented as targets and they had a similar structure to that of the experimental targets. They were always preceded by a word prime. In all cases, the target nonwords were pronounceable as well as orthographically legal. Thus, there were a total of 144 word prime–target pairs and 144 word prime–nonword target pairs.

Four different versions of the experiment were constructed so that participants did not see any experimental prime–target pair more than once, but across participants the 72 target words appeared under the four priming conditions. The 72 filler prime–target pairs and the word prime–nonword target pairs were the same in the four versions. All primes were lower case, whereas targets were upper case.

A practice block of 12 items was constructed so that participants could familiarise themselves with the experimental task. This block included examples of each type of prime–target pair, in the same proportion as the experimental set.

Procedure and apparatus. The task used in this experiment was lexical decision with a priming procedure. Participants were tested in separate sound-proof booths. They were presented with 288 prime–target pairs in a computer-controlled video display in which the timing of the display was synchronised with the video raster. When participants pressed a foot-switch connected to the computer, a fixation point ''#'' appeared for 1000 ms. Then the prime word, in lower case letters, was displayed for 250 ms, immediately followed by the target, in upper case letters for 1000 ms. Each stimulus appeared in the centre of the screen superimposed on the preceding one. Participants were instructed to decide whether the sequence of letters in upper case was a word or not. They indicated their decisions by pressing one of two response buttons, using their preferred hand for the ''yes'' responses. The order of presentation of the items was randomised for each participant. Feedback about the reaction time and the response accuracy was provided after each trial. The stimuli were displayed and the reaction times and error percentages recorded by the DMastr package developed by K. I. and J. C. Forster (1990).

After completing the practice block, participants were allowed to ask questions about the task they had to perform. Then the experiment started. The experiment took approximately 20 min.

Results and discussion

Trials on which participants made an incorrect response were discarded from the analyses. Reaction times that were more than two standard deviations above and below the participant's mean in all conditions were trimmed to the appropriate cutoff values to moderate the influence of outliers. Any participant who made more than 15% of errors was replaced.

The means of reaction times and percentage of errors in each of the priming conditions are presented in Table 2.

TABLE 2
Reaction times and percentage of errors (in parentheses) in lexical decision and semantic decision tasks

	Lexical decision	*Semantic decision*
Identity	567 (2.7)	621 (3.0)
Very close	630 (2.9)	653 (3.9)
Close	645 (3.2)	663 (3.9)
Control	659 (4.7)	680 (5.4)

Separate ANOVAS with repeated measures were carried out with the RT and the error data with participants and items as random variables. The ANOVA performed on the RT measures revealed a significant the effect of word relation, $F_1(3, 57) = 74.28$, $p < .001$; $F_2(3, 69) = 65.1$, $p < .001$.

Planned comparisons between the related priming conditions and the control condition showed a reliable priming effect in the identity condition, $t_1(59) = –12.02$, $p < .001$; $t_2(71) = –12.97$, $p < .001$. The same pattern of effects was observed in the two semantically related conditions. Participants were significantly faster in the very close semantic condition than in the control condition, $t_1(59) = –3.97$, $p < .001$; $t_2(71) = –4.49$, $p < .001$, and the difference between the close semantic condition and the control condition was also significant, $t_1(59) = –1.97$, $p = .05$; $t_2(71) = –2.36$, $p < .05$.

When comparing the priming effects in the two semantic conditions, we used a one-tailed *t*-test, since we expected the semantic priming effect to be greater for the very close word pairs than for the close ones (29 ms vs. 14 ms). The difference between those effects was reliable, $t_1(59) = –2.58$, $p < .01$; $t_2 (71) = –1.89$, $p < .05$.

The ANOVAs for the percentage of error data showed a reliable main effect of the semantic relation, $F_1(3, 57) = 2.78$, $p < .05$; $F_2 (3, 69) = 2.61$, $p = .05$. As in the reaction time analyses, planned comparisons revealed a significant priming effect in the identity condition, $t_1(59) = –2.22$, $p < .05$; $t_2(71) = –2.34$, $p < .05$. Similarly, participants made significantly fewer errors in the very close semantic condition than in the control condition, $t_1(59) = –2.00$, $p < .05$; $t_2(71) = –2.34$, $p < .05$. However, the difference between the percentage of errors in the close semantic condition and the control condition did not reach significance, $t_1(59) = –1.72$, $p = .09$; $t_2(71) = –1.69$, $p = .09$.

The results of this experiment clearly showed that semantically related words produced reliable priming effects, demonstrating that automatic semantic priming can be obtained in the absence of association. In this respect, our results are in the same line as those reported by Vigliocco et al. (2004), and suggest that previous inconsistent findings regarding priming with words related in meaning could have been due to the characteristics of the stimuli used (e.g., weak semantic relationship between primes and targets). Furthermore, Vigliocco et al. observed that the semantic distance between primes and targets predicted the amount of semantic priming obtained in a lexical decision task. Similarly, our findings showed that the magnitude of the semantic priming effect depends on the degree of semantic similarity between primes and targets. Therefore, it can be concluded that the amount of priming obtained (at least in the lexical decision task) appears to depend on the degree of feature overlap between primes and targets. In the next experiment, we used a semantic decision task to examine priming effects.

EXPERIMENT 2

Method

Participants. Sixty first-year Psychology undergraduates took part in this experiment as a course requirement. All of them had either normal or corrected vision. None of them participated in Experiment 1.

Materials and design. The experimental set included the same 72 triplets as in Experiment 1 (see Appendix B). Each triplet contained a target word, and two semantically related words (a very close and a close word). The 72 target words were presented under the same four priming conditions as in the previous experiment: (a) an *identity condition* (e.g., *burro–BURRO*, donkey–DONKEY); (b) a *very close semantic condition* (e.g., *caballo–BURRO*, horse–DONKEY); (c) a *close semantic condition* (e.g., *oso–BURRO*, bear–DONKEY); and, finally, (d) a *control condition* (e.g., *dedal–BURRO*, thimble–DONKEY). In addition to the experimental word pairs, we selected an additional set of 216 filler prime–target pairs. Within this set, there were: (a) 63 pairs in which the prime was a concrete noun and the target was an abstract one and which were not related in meaning; (b) 72 unrelated pairs in which the prime was an abstract noun and the target was a concrete one; (c) 63 prime–target pairs that were abstract nouns and not semantically related; and, finally, (d) 18 pairs in which prime and target were semantically related abstract nouns. This last set of filler items was included to reduce the possibility of participants using the retrospective processing strategy. The related abstract nouns were not part of the experimental set but they required a ''no'' response, so it is less likely for participants to use relatedness as a cue to the ''yes'' response. Table 3 shows the different types of filler word pairs and examples of each of them.

Four different versions of the experiment were constructed so that participants did not see any experimental prime–target pair more than once, but across participants the 72 target words appeared under the four priming conditions. The 216 filler prime–target pairs were the same in the four versions. It is important to mention that in each version of the experiment, the proportions of concrete nouns (i.e., targets to which participants had to respond ''yes'') was .5, and that

TABLE 3
Examples of the different types of filler items used in Experiment 2

Prime–target pairs	*Examples*
Concrete–abstract (unrelated)	*uniforme–soledad* (uniform–loneliness)
Abstract–concrete (unrelated)	*actuación–garganta* (performance–throat)
Abstract–abstract (unrelated)	*mentira–intuición* (lie–intuition)
Abstract–abstract (related)	*miseria–pobreza* (misery–poverty)

only 25% of the word pairs were semantically related (including the word pairs in the identity condition). The remaining 75% were unrelated.

A practice block of 12 items was constructed so that participants could familiarise themselves with the experimental task. This block included examples of each type of prime–target pair, in the same proportion as the experimental set.

Procedure and apparatus. The procedure was exactly the same as in Experiment 1, except that a semantic decision task was used. In particular, participants were asked to judge whether or not the word that would appear in upper-case letters on a computer screen was a concrete noun. They were told to indicate their decisions by pressing one of two buttons. The ‘‘yes’’ response was always made with the preferred hand.

Results and discussion

Trials on which participants made an incorrect response were discarded from the analysis. Reaction times that were more than two standard deviations above and below the participant's mean in all conditions were trimmed to the appropriate cutoff values to moderate the influence of outliers. Any participant who made more than 15% of errors was replaced. Only data from the experimental items were analysed.

Table 2 shows the mean reaction times and percentage of errors in each of the experimental priming conditions. Separate ANOVAS with repeated measures were carried out with the RT and the error data with participants and items as random variables. As in Experiment 1, the ANOVA performed on the RT measures revealed a significant effect of semantic similarity, $F_1(3, 57) = 22.77$, $p < .001$; $F_2(3, 69) = 20.70$, $p < .001$.

Planned comparisons carried out between the related priming conditions (identity, very close, and close) and the unrelated control condition revealed that participants responded significantly faster in the identity condition than in the control condition, $t_1(59) = –7.24$, $p < .001$; $t_2(71) = 7.03$, $p < .001$. Similarly, participants responded significantly faster to the targets when the primes were very close words than when they were unrelated, $t_1(59) = –3.69$, $p < .001$; $t_2(71) = –4.08$, $p < .001$. The same pattern of results was observed when the close semantic condition was compared with the control condition; that is, reaction times were significantly faster in the former than in the latter, $t_1(59) = –2.65$, $p < .05$; $t_2(71) = 2.14$, $p < .05$.

As shown in Table 2, the very close semantic condition produced greater priming effects than the close semantic condition (27 ms vs. 17 ms). These two effects were compared using a one-tailed *t*-test, since we expected the semantic priming effect to be greater for the very close word pairs than for close ones. The comparison revealed that the difference between the two effects did not reach significance, $t_1(59) = –1.31$, $p = .09$; $t_2(71) = –1.14$, $p = .13$.

The ANOVAS for percentage of error data showed a significant main effect of semantic similarity, $F_1(3, 57) = 2.93$, $p < .05$; $F_2(3, 69) = 3.02$, $p < .05$. Planned comparisons only showed a significant priming effect in the identity condition, $t_1(59) = -3.30$, $p < .005$; $t_2(71) = -2.66$, $p < .05$. There were no significant priming effects either in the very close semantic condition, $t_1(59) = -1.50$, $p = .14$; $t_2(71) = -1.73$, $p = .09$, or in the close semantic condition, $t(59) = -1.55$, $p = .13$; $t_2(71) = -1.78$, $p = .08$.

The above results provided further evidence that automatic semantic priming can be obtained in the absence of association. Similarly, they showed once again that both very close and close word primes facilitated the processing of target words. As in Experiment 1, the results of this experiment showed that very close words produced more priming than close words, although in this case the difference between the two semantic conditions did not reach significance. Nevertheless, it should be emphasised that the size of the difference was similar in the two experiments (15 ms and 10 ms for Experiments 1 and 2, respectively; see Table 2).

Our pattern of priming effects obtained with the two semantic relations differed from McRae and Boisvert's (1998) findings. Whereas we obtained significant priming effects when the degree of semantic similarity was high (very close pairs) and when it was low (close pairs), McRae and Boisvert only found effects with high similarity semantic relations, even though we used the same task and priming procedure as they did. We will try to account for the difference between the two studies in the General Discussion.

GENERAL DISCUSSION

The aim of the experiments in this study was to examine priming effects between semantically related words, using a standard semantic priming paradigm. Following previous studies performed in English (McRae et al., 1997; Vinson & Vigliocco, 2002), we defined meaning similarity in terms of semantic features overlap. In order to estimate the degree of semantic similarity, we used two different tasks for the first time in Spanish: similarity rating and feature generation. These two tasks allowed us to select two sets of Spanish word pairs that differed significantly in their similarity of meaning (i.e., very close and close words). What is more, like McRae et al. (1997), we found a significant correlation between the results of the similarity rating task and the feature generation task. This correlation suggests that similarities are rated on the basis of information about semantic features and, more importantly, it provides support for the validity of the two measures to estimate the degree of semantic similarity. It is also important to mention that although some studies in Spanish have examined priming between semantically related words (e.g., Perea & Rosa, 2002; Puerta-Melguizo et al., 1998), to our knowledge, no previous work in this

language has tested to what extent the degree of semantic similarity determines the size of priming effects.

The two experiments we have reported used the same tasks and priming procedures as previous studies (McRae & Boisvert, 1998; McRae et al., 1997; Vigliocco et al., 2004), that is, a lexical decision task (Experiment 1) and a semantic decision task (Experiment 2). Adopting the appropriate measures to reduce the influence of strategic factors to a minimum, we observed significant semantic priming effects in the two tasks. In the lexical decision task, words that were closely related in meaning (i.e., very close words) produced significantly greater priming effects than words that were more distant in meaning (i.e., close words). In the semantic decision task, we also found significant priming effects in the two semantic conditions (very close and close words). Although in this case the difference between the two conditions failed to reach significance, it was of a similar size to the one observed with the lexical decision task. These findings are not only further evidence to support the existence of purely automatic semantic priming effects; they also show that these effects are sensitive to the degree of meaning similarity.

As mentioned earlier, our lexical decision data are consistent with those reported by Vigliocco et al. (2004), who used the same task to find that the degree of semantic similarity predicted the amount of priming. Our semantic decision findings, however, are in contrast to those obtained by McRae and Boisvert (1998), who did not find evidence of priming effects with the more distant semantic prime–target pairs (equivalent to our close words) when they used a 250 ms SOA (see their Exp. 3). How can we account for the difference between both sets of findings? On the one hand, this difference cannot be attributed either to the task or to the procedure used, since we used the same semantic decision task and the same priming procedure and SOA (250 ms) as McRae and Boisvert. On the other hand, the different pattern of priming effects is not likely to be due to strategic factors, because we adopted, as they did, the appropriate measures to reduce the influence of the two strategies participants might use in the semantic decision task (see materials in Experiment 2). A third possibility that could be considered is that McRae and Boisvert's low semantic similarity word pairs were less semantically related than our close word pairs. In order to compare the degree of similarity between McRae and Boisvert's word pairs and ours, we asked a group of 73 additional participants to judge the meaning similarity of very close, close, and control word pairs from the two experimental sets. We used the same scale as they did; that is, a scale from 1 (not at all similar) to 9 (exactly the same thing). We also included in the same similarity judgement task Vigliocco et al.'s word pairs (very close, close, and control word pairs) since these authors found, as we did, significant semantic priming effects with close word pairs. The results of the similarity judgement task were as follows. The mean similarity ratings for McRae and Boisvert's words were 6.2, 3.7, and 1.4 for very close, close, and control word pairs,

respectively. In the case of Vigliocco et al.'s words these means were 5.2, 4.8, and 1.4, and in our case, they were 6.2, 4.1, and 1.4.[2] The most critical comparison is between the close word pairs from the three studies. These comparisons revealed that McRae and Boisvert's close word pairs were significantly less similar (3.7) than either our close word pairs (4.1) or Vigliocco et al.'s close word pairs (4.8). The difference between the latter two was also significant. In the case of the very close words, McRae and Boisvert's pairs (6.2) and our pairs (6.2) were both more significantly similar than Vigliocco et al.'s very close words (5.2). None of the other comparisons reached significance.

On the basis of the results mentioned above, we should first point out that the mean similarity judgements we obtained with McRae and Boisvert's (1998) word pairs are very similar to the ones they provided themselves. The same is true for the two similarity judgements we obtained with our pairs which confirm the validity of this measure. More importantly, we can conclude that our semantic priming effects differed from McRae and Boisvert's for the close word pairs because the meaning similarity between our pairs is higher than theirs, even if the difference is very small (0.4). The finding that only our close pairs and the ones used by Vigliocco et al. (2004) showed significant priming effects suggests that a minimum degree of semantic similarity is required for these effects to emerge. Once this minimum is achieved, the magnitude of semantic priming would depend on how similar primes and targets are. Further evidence to support this conclusion comes from the difference in the magnitude of priming effects we observed between close and very close word pairs in the two different tasks we used. Although such a difference only reached significance in the lexical decision task, our findings, together with those of Vigliocco et al., can be interpreted as clear evidence that semantic priming effects are sensitive to the degree of semantic similarity. More experiments are needed to determine why the difference between very close and close semantically related word pairs was not significant in the semantic decision task, and to test the generality of these effects in several experimental tasks.

Can the results of our experiments tell us anything about the validity of models of semantic memory? The finding that priming effects are sensitive to the degree of semantic similarity is, in principle, compatible with both spreading activation models (Collins & Loftus, 1975) and distributed memory models

[2] Statistical analyses showed that, as far as very close pairs were concerned, there was no difference between McRae and Boisvert's pairs and our word pairs, $t(93) = 0.13$, $p = .89$, but the difference reached significance if we compare Vigliocco et al.'s pairs to both McRae et al.'s pairs, $t(50) = 3.64$, $p < .001$, and ours, $t(99) = –5.50$, $p < .001$. Our close pairs were significantly more similar than McRae and Boisvert's pairs, $t(93) = –2.25$, $p = .026$, and significantly less similar than Vigliocco et al.'s pairs, $t(90) = 4.72$, $p < .001$. Vigliocco et al.'s close pairs were also significantly more similar than McRae and Boisvert's pairs, $t(50) = –5.49$, $p < .001$. Finally, there were no significant differences between the control pairs in the three studies, $ts < 1$.

(e.g., McRae et al., 1997; Plaut, 1995). Both types of models adopt a decompositional view of meaning and assume that word meaning can be represented by bundles of features. A spreading activation model such as that proposed by Collins and Loftus, for instance, considers featural similarity as one of the organising principles of semantic memory. According to this model the strength of connections between concepts depends on the number of features in common. Concepts that have many features in common are joined by stronger links than concepts that share fewer features. Thus, this model predicts that the former produce more priming effects than the latter. The same prediction can be made from some distributed memory models (e.g., McRae et al., 1997; Plaut, 1995). These models consider that word meaning is represented by a pattern of activation over units that represent semantic features or micro features. Within this view, words that are related in meaning share a set of semantic features that are encoded as overlapping patterns of activation. Given these assumptions, these models also predict that words that share more semantic features produce more priming effects than words that share fewer semantic features.

In sum, our findings are compatible with both models of semantic memory. However, more experiments need to be performed in order to provide further evidence about the role of semantic features in the representation of word meaning.

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APPENDIX A
Correspondence analysis and computations of semantic distances

Correspondence analysis is a descriptive/exploratory technique designed to analyze simple two-way and multiway tables containing some measure of correspondence between the rows and columns. In our case, we analysed the crosstabulation table of frequencies for semantic features and the three words in every triplet. Table A1 shows the crosstabulation table related to the triplet *burro*/*caballo*/*oso*.

We computed the correspondence analysis to produce a spatial representation for the triplet in two dimensions. This representation reproduces the similarity (and distances) between the relative

TABLE A1
Crosstabulation table of frequencies for semantic features and words

Semantic features	*Words*		
	burro (donkey)	*caballo (horse)*	*oso (bear)*
es un animal (it is an animal)	22	16	16
tiene orejas (it has ears)	22	17	12
tiene patas (it has legs)	17	25	7
tiene pelo (it has fur)	17	22	15
es un animal de carga (it is a beast of burden)	14	6	0
tiene cuatro patas (it has four legs)	9	9	0
es de tiro (it is a cart-beast)	9	0	0
vive en el campo (it lives in the country)	7	0	0
tiene orejas largas (it has long ears)	11	0	0
tiene hocico (it has a snout)	6	0	0
es marrón (it is brown)	6	6	8
tiene cola (it has a tail)	6	19	0
tiene ojos (it has eyes)	5	0	0
es gris (it is grey)	5	0	0
es grande (it is big)	0	9	18

English translation is shown in parenthesis.

TABLE A2
Coordinates for the two-dimensional solution

Words	*Column coordinates*	
	First dimension	*Second dimension*
burro (donkey)	–0.371	0.455
caballo (horse)	–0.884	0.812
oso (bear)	–1.324	–0.670

English translation is shown in parenthesis.

frequencies for the words, across the semantic features. Table A2 shows the word coordinates for dimensions.

Unfortunately, the scaling of the coordinates obtained after analysing each crosstabulation table would not allow word triplets: The coordinates had to be scaled to a two-dimensional space where the longest possible value for a coordinate was the absolute value 1. To do this, we scaled the two-dimensional solution shown in Table A2 so that the sum of the table entries across cells was equal to 1. The coordinates for the two-dimensional solution after overall scaling are shown in Table A3, and the corresponding graphical representation is shown in Figure A1.

Then the Euclidean distance between words *burro* and *caballo* was computed as follows:

$$d_{1,2} = \sqrt{(-0.186 + 0.443)^2 + (-0.228 - 0.407)^2} = 0.3129,$$

and the Euclidean distance between words *burro* and *oso* was computed as follows:

$$d_{1,3} = \sqrt{-0.186 + 0.663)^2 + (-0.228 + 0.336)^2} = 0.7385$$

We repeated this analysis for each triplet of words to obtain the corresponding distances $d_{1,2}$ and $d_{1,3}$.

TABLE A3
Coordinates for the two-dimensional solution after overall scaling

Words	*Column coordinates*	
	First dimension	*Second dimension*
burro (donkey)	–0.186	0.228
caballo (horse)	–0.443	0.407
oso (bear)	–0.663	–0.336

English translation is shown in parenthesis.

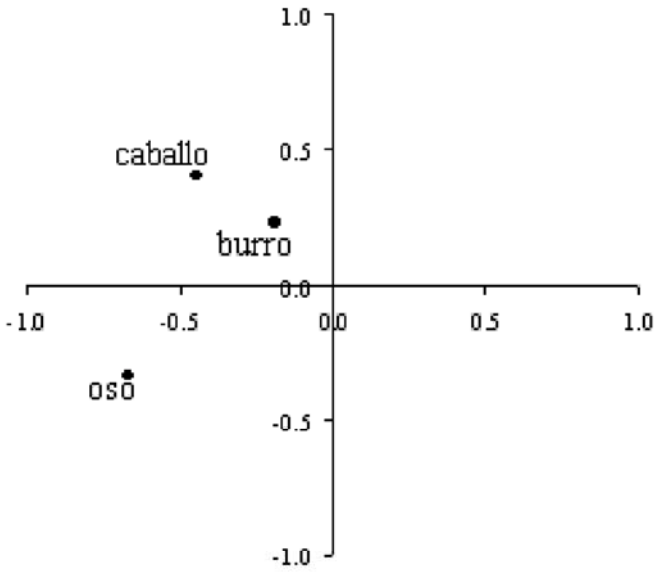

Figure A1. Plot of coordinates in the scaled space for the word triplet *burro* (donkey), *caballo* (horse), *oso* (bear).

APPENDIX B
WORD TRIPLETS USED IN EXPERIMENTS 1 AND 2

Target	*Very close*	*Close*
Burro (donkey)	caballo (horse)	oso (bear)
Silla (chair)	butaca (armchair)	estantería (shelves)
Cama (bed)	sofá (sofa)	mesa (table)
Zumo (juice)	batido (milk shake)	aceite (oil)
Garbanzos (chickpeas)	lentejas (lentils)	fideos (noodles)
Merluza (hake)	lenguado (sole)	sapo (toad)
Queso (cheese)	cuajada (curd)	flan (crème caramel)
Trigo (wheat)	centeno (rye)	avellana (hazelnut)
Acelgas (chard)	espinacas (spinach)	calabaza (pumpkin)
Hilo (thread)	lana (wool)	cadena (chain)
Calcetines (socks)	medias (tights)	bañador (swimsuit)
Vaso (glass)	taza (cup)	fuente (serving dish)
Cuchillo (knife)	espada (sword)	pistola (gun)
Cordero (lamb)	cabra (goat)	ciervo (deer)
Madera (wood)	corcho (cork bark)	cemento (concrete)
Guisante (pea)	judía (bean)	patata (potato)
Yegua (mare)	mula (mule)	elefante (elephant)
Tormenta (storm)	huracán (hurricane)	terremoto (earthquake)
Búho (owl)	águila (eagle)	avestruz (ostrich)
Servilleta (napkin)	mantel (tablecloth)	manta (blanket)

(continued overleaf)

Paloma (pigeon)	gaviota (seagull)	delfín (dolphin)
Barro (mud)	tierra (soil)	césped (grass)
Sábana (sheet)	colcha (bedspread)	tapete (runner)
Ventana (window)	puerta (door)	armario (wardrobe)
Peca (freckle)	verruga (wart)	grano (spot)
Rana (frog)	salamandra (salamander)	serpiente (snake)
Gorrión (sparrow)	golondrina (swallow)	ardilla (squirrel)
Calle (street)	camino (path)	túnel (tunnel)
Lagartija (small lizard)	lagarto (lizard)	ratón (mouse)
Perejil (parsley)	tomillo (thyme)	vainilla (vanilla)
Cerdo (pig)	jabalí (wild boar)	cebra (zebra)
Hielo (ice)	granizo (hailstone)	niebla (fog)
Lechuga (lettuce)	col (cabbage)	champiñón (mushroom)
Tijeras (scissors)	alicates (pliers)	destornillador (screwdriver)
Muela (tooth)	colmillo (fang)	cuerno (horn)
Pulpo (octopus)	calamar (squid)	salmón (salmon)
Pendiente (earring)	anillo (ring)	reloj (clock)
Lavadora (washing)	lavaplatos (dishwasher)	horno (oven)
Fresa (strawberry)	cereza (cherry)	nuez (walnut)
Melocotón (peach)	ciruela (plum)	nabo (root vegetable)
Cerilla (match)	mechero (lighter)	vela (candle)
Techo (ceiling)	tejado (roof)	pasillo (corridor)
Sombrero (hat)	gorra (cap)	pantalones (trousers)
Pañuelo (handkerchief)	bufanda (scarf)	guantes (gloves)
Alfombra (carpet)	esterilla (small mat)	parqué (parquet)
Colchón (mattress)	cojín (cushion)	cortina (curtain)
Naranjo (orange tree)	limonero (lemon tree)	rosal (rosebush)
Pato (duck)	ganso (goose)	tortuga (turtle)
Tiburón (shark)	orca (killer whale)	cangrejo (crab)
Gusano (worm)	anguila (eel)	abeja (bee)
Lluvia (rain)	nieve (snow)	tornado (tornado)
Azúcar (sugar)	canela (cinnamon)	harina (flour)
Mono (monkey)	gorila (gorilla)	vaca (cow)
Cubo (bucket)	barreño (large bowl)	escoba (brush)
Atún (tuna)	lubina (bass)	foca (seal)
Mariposa (butterfly)	polilla (moth)	pavo (turkey)
Mejillón (mussel)	almeja (clam)	ballena (whale)
Manzana (apple)	naranja (orange)	coliflor (cauliflower)
Barco (boat)	canoa (canoe)	avión (plane)
Jamón (ham)	salchichón (salami)	tortilla (omelette)
Uva (grape)	pasas (raisins)	remolacha (beetroot)
Perro (dog)	hiena (hyena)	buey (ox)
Pimiento (pepper)	berenjena (aubergine)	níspero (medlar)
Lata (tin)	bote (can)	bandeja (tray)
Muñeca (doll)	marioneta (marionette)	puzzle (puzzle)
Botella (bottle)	jarra (jug)	plato (dish)
Calabacín (zucchini)	pepino (cucumber)	limón (lemon)
Zanahoria (carrot)	rábano (radish)	albaricoque (apricot)
Ensalada (salad)	escalivada (Catalan dish)	potaje (hotpot)
Rodilla (knee)	codo (elbow)	ojo (eye)
Galleta (biscuit)	pastel (cake)	canelones (cannelloni)
Televisión (television)	vídeo (video)	radio (radio)

ARTÍCULO II

Ferré, P., Sánchez-Casas, R. y Guasch, M.

Can a horse be a donkey? Semantic and form interference effects in translation recognition in early and late proficient and non-proficient Spanish-Catalan bilinguals

Language Learning, 56, 571–608
(2006)

Artículo 2

Ferré, P., Sánchez-Casas, R. y Guasch, M. (2006). Can a horse be a donkey? Semantic and form interference effects in translation recognition in early and late proficient and non-proficient Spanish-Catalan bilinguals. *Language Learning, 56*, 571–608.

Objetivos específicos

- Poner a prueba las predicciones del Modelo Jerárquico Revisado en cuanto al mayor uso de la ruta léxica por parte de los bilingües poco competentes en su segunda lengua, y un mayor uso de las conexiones directas con el nivel conceptual en el caso de los bilingües muy competentes en su segunda lengua.

- Examinar el peso relativo del nivel de competencia en la segunda lengua y de la edad de adquisición a la hora de desarrollar conexiones directas entre la L2 y el nivel semántico/conceptual.

- Poner a prueba el Modelo de Rasgos Distribuidos explorando la propuesta de que el rendimiento de los bilingües puede verse afectado por el grado de relación semántica entre una falsa traducción y la traducción correcta.

Predicciones

Según la evidencia revisada en cuanto a la tarea de reconocimiento de traducciones, esperaríamos confirmar las predicciones del MJR. Para ello, los bilingües más competentes deberían mostrar mayor interferencia ante las manipulaciones semánticas que ante las formales, y lo contrario en el caso de los bilingües menos competentes.

Respecto a la importancia del nivel de competencia frente a la edad de adquisición en la posibilidad de mediación conceptual desde la L2, existen evidencias con el paradigma de *priming* semántico que señalan que son importantes ambas variables (ej., Kotz, 2001; Kotz y Elston-Güttler, 2004), mientras que otros estudios señalan que es más relevante la edad de adquisición (ej., Silverberg y Samuel, 2004). Además de que estos resultados son dispares, la tarea emplada por nosotros fue de reconocimiento de traducciones, por lo que sería aventurado hacer una predicción. Baste decir que el nivel de competencia es una variable tenida en cuenta por el MJR, mientras que la edad de adquisición no está contemplada en el modelo.

Respecto al tercer objetivo, teniendo en cuenta la evidencia previa de Talamas et al. (1999) y Sunderman y Kroll (2006), se esperaría confirmar experimentalmente que el grado de relación semántica entre palabras de distinta lengua modula la cantidad de interferencia producida en los bilingües, apoyando así las predicciones del MRD.

Resumen

En el siguiente artículo se puso a prueba la propuesta del Modelo Jerárquico Revisado (Kroll & Stewart, 1994) acerca del desarrollo de las conexiones entre la L2 y la L1 y entre la L2 y el nivel semántico/conceptual. Las lenguas del estudio fueron el castellano como primera lengua y el catalán como segunda lengua.

Los participantes implicados fueron un primer grupo de bilingües tempranos competentes, un segundo grupo de bilingües tardíos competentes y un tercer grupo de bilingües no competentes (aprendices de catalán). La comparación entre los dos primeros grupos permitió evaluar el papel de la edad de adquisición de la segunda lengua en el acceso al nivel conceptual desde la L2, mientras que la inclusión del tercer grupo permitió estudiar la influencia del nivel de competencia.

Los participantes realizaron una tarea de reconocimiento de traducciones de L2 a L1, en la que tenían que decidir si las dos palabras que se les presentaban eran traducciones o no. La segunda palabra de cada par podía ser la traducción correcta de la primera (ej., *blat* – trigo), una palabra con una relación semántica muy cercana (ej., *blat* – centeno), una palabra con una relación semántica cercana en menor medida que la anterior (ej., *blat* – avellana), un vecino de traducción (ej., *blat* – azul; donde '*blau*', que es la traducción de 'azul', se parece a '*blat*') o una palabra no relacionada en absoluto (ej., *blat* – ropa). Se incluyeron tres condiciones de palabras no relacionadas (una para cada condición relacionada) igualadas en frecuencia y lon-

gitud a las palabras de las cuales hacían de control. En todas las condiciones la primera palabra aparecía siempre en catalán (L2) y la segunda siempre en castellano (L1).

En los resultados se observó que el grupo de bilingües tempranos competentes mostraba efectos de interferencia tanto en la condición de relación semántica muy cercana, como en la condición de parecido formal. Aunque las manipulaciones semánticas afectaron más a sus respuestas que las de forma, estos resultados sugieren que las conexiones léxicas no desaparecerían con el aumento de la competencia en la L2.

Por su parte, el grupo de bilingües tardíos competentes mostró, igual que el grupo anterior, claros efectos de interferencia con los pares relacionados en la forma. Mientras que en esta condición los efectos de interferencia se revelaron tanto en un incremento del tiempo de reacción como en un mayor número de errores, en la condición de relación semántica muy cercana se observaron efectos de interferencia únicamente como un incremento del número de errores, aunque dicho efecto fue mayor que en la condición de forma. Así, aunque ambos grupos de bilingües competentes no se comportaron de forma exactamente igual, sí mostraron una mayor sensibilidad a las manipulaciones semánticas que a las formales. Este hecho apuntaría a que el nivel de competencia en la L2 sería más relevante que la edad de adquisición a la hora de favorecer la mediación conceptual en bilingües.

Por otra parte, los datos obtenidos con el grupo de bilingües menos competente son consistentes con el MJR, ya que mostraron una clara influencia de la relación formal en los tiempos de reacción y en el porcentaje de errores y una menor interferencia de las manipulaciones semánticas observable solamente en los datos de los errores.

Finalmente, nuestros resultados confirman experimentalmente que la magnitud de la interferencia en las condiciones semánticas puede depender del grado de relación que tengan entre sí las palabras, ya que cuando se produjo dicha interferencia, solamente se observó en la condición muy cercana pero no en la cercana. Este hecho es plenamente consistente con las predicciones del MRD en el sentido de que cuanto más parecidas fueran ambas palabras en su significado, más nodos semánticos en común tendrían activados, y por lo tanto más difícil sería tomar una decisión.

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Can a Horse Be a Donkey? Semantic and Form Interference Effects in Translation Recognition in Early and Late Proficient and Nonproficient Spanish-Catalan Bilinguals

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The present study investigates the developmental aspect of the revised hierarchical model (Kroll & Stewart, 1994) concerning the access to the conceptual store from the second language (L2). We manipulated the level of proficiency and age of L2 acquisition. We tested Spanish-Catalan bilinguals (49 early proficient bilinguals, 28 late proficient bilinguals, and 28 late nonproficient bilinguals) in a translation recognition task in which they had to decide whether the second of two words was the correct translation of the first. The second word of the pair could be the true translation, a word related in form, a word more or less related in meaning, or an unrelated word. The results showed that both early and late proficient bilinguals were more sensitive to the semantic than to

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the form manipulation, but only in the case of words with a very close meaning. On the contrary, the late nonproficient group exhibited larger effects of the form than of the semantic manipulation.

One of the questions that have attracted the attention of researchers in bilingualism has been the representation of the two languages' vocabulary in memory. Different studies have been conducted to determine whether bilingual memory is composed of two separate stores, one belonging to each language, or a single store shared between the two languages. Today, the most accepted conception of bilingual memory is that of a hierarchical system. From this point of view, bilingual memory is seen as composed of two levels of representation: one storing the word form (lexical level) and the other one storing the word meaning (conceptual level).

Concerning this hierarchical model, a further question of interest has been to elucidate whether the language units in each of the above-mentioned levels are integrated across languages or whether they are represented separately at the two levels of representation. An answer to this question has been the revised hierarchical model (RHM; Kroll, 1993; Kroll & Sholl, 1992; Kroll & Stewart, 1994; Sholl, Sankaranarayanan, & Kroll, 1995), which has been very influential in research in bilingualism for the past 10 years. The model includes both direct connections between lexical representations in the two languages and direct links between lexical representations in each language and the conceptual store. Thus, the conceptual store is shared between the first language (L1) and the second language (L2) (see Figure 1). An important contribution of the RHM is that it is, up to now, the model that most explicitly has tried to account for differences in L2 performance related to bilinguals' proficiency. The RHM assumes that in L2 beginners, the direct links between L2 lexical representations and the conceptual store are very weak. Thus, they would rely almost exclusively on lexical connections between the L2 and the L1. It would mean that bilinguals' performance in this stage would be more affected by form-related variables than by

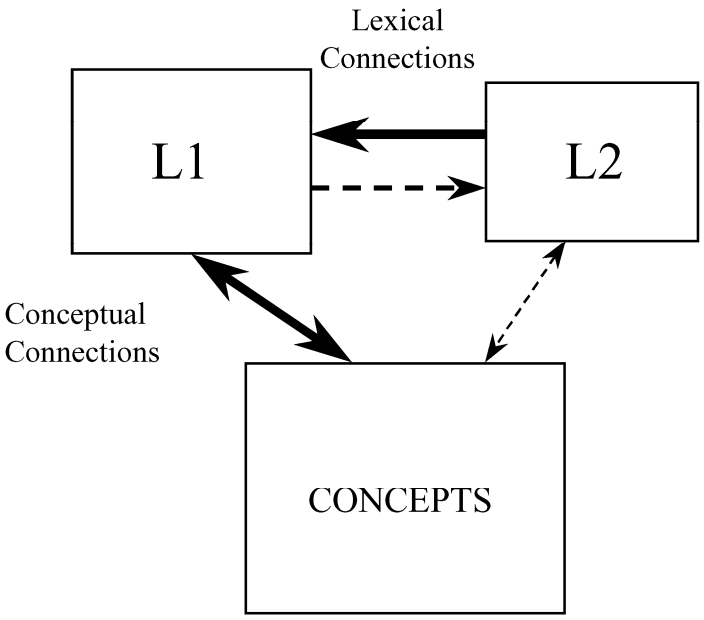

Figure 1. The revised hierarchical model (adapted from Kroll & Stewart, 1994).

semantic variables. For example, when L2 beginners have to perform a translation recognition task in which participants have to decide whether an L1 word (e.g., garlic) is the correct translation of an L2 word (e.g., *ajo*) and when L2 words similar in form (e.g., *ojo*-eye) or in meaning (e.g., *cebolla*-onion) to the correct translation are presented, beginners' performance would be more affected by the form similarity between the words (*ajo-ojo*) than by their similarity in meaning (*ajo-cebolla*). With increasing exposure to the L2 and as learners become more proficient, direct connections between the L2 and the conceptual store would develop and be strengthened. As a consequence, the performance of proficient bilinguals would be clearly affected by semantic variables. Furthermore, because the lexical connections between L1 and L2 words would not disappear with increasing proficiency, performance of proficient bilinguals should also be affected by form manipulations.

Some studies have confirmed the prediction of the RHM concerning the differential pattern expected to be found in nonproficient and proficient bilinguals. For example, priming between languages has been obtained in a large number of cross-language semantic priming studies conducted with proficient bilinguals, thus suggesting that they are able to conceptually mediate an L2 (e.g., Chen & Ng, 1989; De Groot & Nas, 1991; Kroll & Borning, 1987). Similar results have been obtained by De Groot and Hoeks (1995), who studied the effects of words' concreteness on a translation production task in a group of Dutch trilinguals who were proficient in English but not proficient in French. The authors found that only when translating to English, but not to French, participants translated concrete words more quickly than abstract words. Given that the concreteness effect has been considered an index of conceptual mediation (De Groot, 1992), these findings constitute additional evidence that only the performance of bilinguals with a certain degree of L2 proficiency is affected by semantic variables.

The most direct test of the developmental pattern concerning conceptual mediation as proficiency in L2 increases has been the study of Talamas, Kroll, & Dufour (1999). These authors tested two groups of English-dominant participants with a different level of proficiency in Spanish in a translation recognition task performed in both L1-L2 (English-Spanish) and L2-L1 (Spanish-English) directions. In the translation recognition task (De Groot, 1992), participants see a word in one language followed by a word in the other language. They have to decide whether the second word is the correct translation of the first one. The task usually includes a set of trials that consist of correct translations (e.g., *ajo*-garlic) as well as several trials that do not. In the study of Talamas et al. (1999), when participants were tested in the L2-L1 (Spanish-English) direction, two types of distractor were included in those trials involving false translations. There was a form-related condition, in which the second word was an English word whose translation in Spanish was similar in form to the Spanish word to be translated (e.g., *ajo*-eye [*ojo*]) and a semantically

related condition, in which the second word was related in meaning to the correct translation (e.g., *ajo*-onion). Talamas et al. (1999) found that the performance of the less proficient bilinguals was especially affected by form similarity (i.e., in false translation pairs, they were slower to reject the second word as a translation of the first one when its Spanish translation was similar in form to the Spanish word to be translated; e.g., *ajo*-eye). Conversely, performance of more proficient participants was especially affected by semantic similarity (i.e., in false translation pairs, they were slower to reject the second word as a translation of the first one when it had a meaning related to that of the true translation; e.g., *ajo*-onion). According to the RHM, this pattern of results clearly suggests that the less proficient bilinguals were particularly relying on lexical connections, whereas the performance of the more proficient bilinguals seemed to be more dependent on the links between L2 and concepts.

However, there were some data in Talamas et al.'s (1999) work that suggest that even the performance of the less proficient bilinguals was affected to some extent by the semantic manipulation, because they were less accurate in responding "no" to false translation pairs if they were semantically related. To examine the effects of semantic interference in more detail, the authors conducted a post hoc analysis in which the semantically related pairs included in their experimental materials were rated for the degree to which they were semantically similar. Then the authors reanalyzed participants' performance considering that new variable (i.e., the degree of semantic similarity between the members of semantically related pairs). Talamas et al. found that the proficient group's performance was affected by both more and less similar pairs, whereas in less proficient bilinguals, a semantic interference effect was only obtained with the more similar ones. The authors concluded that the degree of similarity between pairs of semantically related words can modulate semantic interference effects in bilinguals.

There are other studies that have obtained evidence of conceptual mediation in nonproficient bilinguals. In some of them,

the authors have tried to simulate L2 learning in the laboratory by teaching participants a small set of L2 words in a few sessions (Altarriba & Mathis, 1997; Chen, 1990; De Groot & Keijzer, 2000; Ferré, Sánchez-Casas, & García, 2001). In these studies, after the training phase, participants usually perform some conceptually mediated tasks. Both Altarriba and Mathis and Ferré et al. used a bilingual Stroop task, in which words in the L2 were limited to the translations that participants had just learned. The authors obtained a clear between-languages interference. The same effect was observed in the Altarriba and Mathis work in a translation recognition task. These findings suggest that even individuals with such a limited L2 exposure exhibit conceptual mediation. However, it could be argued that the type of participants included in these studies is different from real bilinguals and that the situation in which they learned L2 words was very artificial.

There are other studies that do not suffer from this problem that have not confirmed the predictions of the RHM. For example, the performance of nonproficient bilinguals has been shown to be affected by conceptual manipulations in a semantic categorization task (Dufour & Kroll, 1995) and in a primed lexical decision task (Frenck-Mestre & Prince, 1997). Furthermore, De Groot and Poot (1997) found that beginner bilinguals were faster in translating from L1 to L2 than from L2 to L1. This result is clearly inconsistent with a model that assumes that in bilinguals with a low proficiency level, the lexical connections (stronger in the L2-L1 direction) would be much more developed than the conceptual ones. In the same study, the authors reported that word imageability affected performance in a translation production task, even in the case of participants with a low fluency level. Given that imageability concerns an aspect of the word's meaning, these findings suggest that even the performance of bilinguals with a low degree of proficiency is influenced by semantic variables.

In most of the above studies that have tested bilinguals with different proficiency levels (e.g., Chen, 1990; De Groot & Hoeks, 1995; De Groot & Keijzer, 2000; De Groot & Poot, 1997; Ferré et al., 2001; Frenck-Mestre & Prince, 1997), participants

are late bilinguals (i.e., they have not acquired L2 early in life) who have not acquired their L2 in immersion settings. Instead, they have learned L2 in a formal instruction context (i.e., by attending courses). In other studies (e.g., Altarriba & Mathis, 1997; Talamas et al., 1999) it is hard to determine, from the description of the participants provided by the authors, whether they have learned L2 early or late in their lives and whether they have acquired their L2 in an immersion setting or by attending courses.

However, both the age of L2 acquisition and the L2 learning context might be relevant variables that could modulate the effects of semantic variables on bilinguals. Concerning the L2 learning context, Kroll, Michael, and Sankaranarayanan (1998) have suggested that when L2 vocabulary is acquired in a formal instruction setting, the common strategy would be to attach new L2 word forms to concepts through L1 words. In contrast, when L2 is acquired in an immersion environment, it is less likely that people use L1 words to learn new L2 vocabulary. In this case, it is more likely that direct links between L2 words and the conceptual store are established. According to that, it would be possible to obtain different semantic effects on the performance of non-proficient bilinguals depending on the context in which they are learning their L2. Up to now, this proposal has not been tested because the context of acquisition has not been a variable commonly manipulated in studies of bilingualism. As previously mentioned, most of this work has focused on bilinguals who have acquired L2 in formal instruction settings.

Concerning age of L2 acquisition, recent studies suggest that the semantic processing of L2 words can be affected by this variable. In particular, Silverberg and Samuel (2004) have shown that the age of L2 acquisition modulates the effects observed in a between-languages semantic priming paradigm. These authors tested Spanish-English bilinguals and found that only participants who had acquired L2 before the age of 7 (early bilinguals) exhibited a semantic priming effect in a lexical decision task in which the primes were L2 words semantically related to the L1 targets. Conversely, the authors failed to find a semantic priming

effect in participants who, although being as proficient as the previous ones, learned their L2 after the age of 7 (late proficient bilinguals). In these bilinguals, priming was observed only when primes were L2 words with a form similar to that of L1 targets. On the contrary, there was not any effect of either semantic or formal relationships between primes and targets on late bilinguals with a low proficiency level. There are other studies that have shown that both age of acquisition and proficiency have to be taken into account when explaining L2 word processing. In particular, Kotz (2001) and Kotz and Elston-Güttler (2004) tested three groups of bilinguals in a primed lexical decision task in which both primes and targets were in L2. Participants were early Spanish-English bilinguals who had started to acquire their L2 before the age of 4 (Kotz) and late German-English bilinguals (i.e., they acquired L2 after that age) who were divided into more and less proficient (Kotz & Elston-Güttler). The authors registered the participants' reaction times and recorded event-related brain potentials. Concerning reaction times, priming was only obtained in proficient bilinguals, regardless of their age of L2 acquisition. However, if we focus on the event-related brain potentials data, priming was observed in early bilinguals but not in late bilinguals, regardless of their level of proficiency. These results suggest that both proficiency and age of acquisition are relevant variables. According to Kotz, Kotz and Elston-Güttler, and Silverberg and Samuel, their findings imply that the RHM should include not only proficiency but also age of acquisition as factors determining the processing of L2 words.

Given all of the above considerations, the aim of the present study was to further investigate the developmental proposal of Kroll and Stewart's (1994) model concerning access to the conceptual store from L2 by examining not only proficiency, as Talamas et al. (1999) did, but also age of acquisition. Furthermore, we were interested in testing bilinguals who had acquired L2 in immersion settings instead of the most commonly used participants in this field of research—bilinguals who have learned

L2 in formal instruction contexts. We selected three groups of Spanish (L1)-Catalan (L2) bilinguals—early bilinguals and late proficient and nonproficient bilinguals—and examined their performance in a translation recognition task performed in the L2-L1 direction. We did not test the L1-L2 direction because it required the knowledge of a large number of L2 words and our nonproficient bilinguals have a rather limited L2 vocabulary. On the other hand, the translation recognition task was chosen because, as Talamas et al., we were interested in testing the effects of semantic and formal manipulations in bilinguals' performance. Therefore, we included in our materials both form-related and semantically related pairs. A semantic or a form interference effect would be obtained if participants were slower to reject (and committed more errors in) semantic-related or form-related distractors, respectively, than unrelated controls. In addition, we were interested in further exploring Talamas et al.'s proposal concerning the possibility that the degree of semantic similarity between distractors and correct translations affects participants' performance. In order to achieve this aim, we included two kinds of semantically related pairs. Half of them were closely related to the correct translation (referred hereafter as "very close pairs") and the remaining half were less closely related to it (referred hereafter as "close pairs").

Following the RHM predictions and concerning L2 proficiency, we would expect nonproficient bilinguals to be more sensitive to form than to meaning manipulations, because direct links between L2 lexical representations and the conceptual store are very weak at this stage. In the case of proficient bilinguals, we hypothesize that they would be sensitive to the semantic manipulation because their two lexicons maintain strong connections with the conceptual store. Thus, we expect them to show clear semantic interference. In addition, because the RHM proposes that lexical connections between L1 and L2 remain active even when the links between L2 and the conceptual store are fully developed, we expect proficient bilinguals to be also affected by the form

manipulation. In addition, as the Kroll and Stewart (1994) model predicts, as L2 proficiency increases, bilinguals should rely more on conceptual than on lexical connections, so proficient bilinguals are expected to be more sensitive to the semantic than to the form manipulation. Regarding the effects of the degree of semantic similarity on participants' performance, it is not clear which prediction will follow from the RHM. If we take into account the results of the post hoc analysis conducted by Talamas et al. (1999), we would expect proficient bilinguals to show semantic interference with both very close and close pairs and nonproficient bilinguals to be only affected by the strongest semantic relation.

Concerning age of acquisition, predictions from the RHM are also not clear either because this model was originally proposed to account for the performance of late L2 learners and did not consider the age of acquisition as a relevant factor. If we focus on Silverberg and Samuel's (2004) results, the prediction should be that only early bilinguals' performance will show conceptual mediation. However, if we consider the reaction times data obtained by Kotz (2001) and Kotz and Elston-Güttler (2004) we might expect the performance of late proficient bilinguals to be more similar to that of the early group than to the late nonproficient participants. Nevertheless, it has to be taken into account that in the above studies, a semantic priming paradigm was employed, whereas the present work uses a translation recognition task.

Method

Participants

Before describing the participants, it is important to give some details about the kind of bilingualism that exists in Catalonia and the type of context in which people learn Catalan. In Catalonia, both Catalan and Spanish are official languages. At the end of the primary school, children are able to speak, understand, read, and write in both languages. In high school, as well

as at the university, classes can be in either of the two languages. Furthermore, both Catalan and Spanish are strongly present in daily life: in the streets, in the shops, in television and radio programs, in newspapers, and so forth.

Taking into account the above description, we can consider that our early bilinguals have acquired Catalan (L2) in an immersion context. On the other hand, the wide exposure to Catalan in daily life makes it possible that the context of L2 acquisition of our late bilinguals has elements of both a formal setting (as most of them have taken Catalan courses) and of an immersion context.

Early bilingual group. Forty-nine third-year psychology students from the Rovira i Virgili University (Tarragona, Catalonia) participated in this experiment. All of them were Spanish-Catalan proficient bilingual speakers. Information about their language history was collected through a detailed questionnaire that was administered in Spanish. All of them were natives of Catalonia, where they acquired both languages during childhood (age of acquisition of Spanish, $\bar{X} = 0.6$, $SD = 1.9$; age of acquisition of Catalan, $\bar{X} = 1.1$, $SD = 2.3$). Because the mean age of this group of bilinguals was 20.3 years, $SD = 4.3$, we can consider that they have approximately 19 years of experience with Catalan.

Participants were asked to rate the frequency of language use (listening, speaking, reading, and writing) for each of their two languages (Spanish and Catalan) on a 5-point scale (1 = almost always in Catalan; 2 = mostly in Catalan; 3 = the same in Catalan and Spanish; 4 = mostly in Spanish; 5 = almost always in Spanish). Although they reported to read in both languages, they read to a greater extent in Spanish, $\bar{X} = 3.4$, $SD = 0.9$, because the university courses required them to read mainly in this language. In contrast, they generally used the two languages equally for listening, $\bar{X} = 3.0$, $SD = 0.8$, and talking, $\bar{X} = 3.0$, $SD = 1.5$, and slightly more Catalan than Spanish for writing, $\bar{X} = 2.8$, $SD = 1.2$. Nevertheless, their self-ratings in these abilities showed a quite balanced use of both languages. Finally, participants rated their competence on a 5-point scale (where 1 is considered a very

poor level of competence and 5 is a very good level). Although they considered themselves very competent on both languages (their mean score was 4.8 for Spanish and 4.6 for Catalan), their self-ratings were higher for Spanish than for Catalan, $t(48) = -2.5$, $p < .05$.

As the language history questionnaire shows, this group of bilinguals was very balanced. They were very competent in Spanish and Catalan and used both of them quite regularly. However, we considered that their L1 was Spanish because they acquired it a bit earlier than Catalan and their self-ratings in competence were significantly higher in Spanish than in Catalan. In addition, these bilinguals employed Spanish more often than Catalan for reading and the experiment in which they were going to participate involved this ability.

Late proficient bilingual group. Twenty-eight participants were tested in this experiment. Some of them belonged to the university community and others were from the Servei Lingüístic de la Universitat Rovira i Virgili de Tarragona and the Escola Oficial d'Idiomes de Tarragona (two official centers in which people can learn Catalan). All of them had Spanish as their native language. Their mean age was 41.1, $SD = 9.1$. Their mean age of acquisition of Catalan (L2) was 19.1 years, $SD = 12.5$, so they have had Catalan for approximately 22 years. Although they acquired L2 late in their lives, they were very competent in both Catalan and Spanish. For a more detailed characterization of their language history, they completed the same questionnaire as early bilinguals.

They were asked to rate the frequency of language use for each of their two languages. Their mean ratings were: 2.9, $SD = 0.9$ for listening; 3.5, $SD = 1.1$ for speaking; 3.6, $SD = 1.1$ for reading; and 3.6, $SD = 1.2$ for writing (where 1 corresponds to "almost always in Catalan" and 5 corresponds to "almost always in Spanish").

Participants were also asked to assess their language competence on a 5-point scale (where 1 is considered a very poor level of competence and 5 is a very good level). Although they considered

themselves very competent on both languages (their mean score was 4.9 for Spanish and 4.2 for Catalan), their self-ratings were higher for Spanish than for Catalan, $t(27) = -8.3$, $p < .001$.

Late nonproficient bilingual group. Twenty-eight participants from the Escola Oficial d'Idiomes de Tarragona and the Centre de Normalització Lingüística de Tarragona (an official center specialized in teaching Catalan) were tested in this experiment. All of them were selected on the basis of the following criteria: Their native language (L1) had to be Spanish, they should not have more than 2 years of residence in Catalonia, and they should not have been taking Catalan courses for more than 1 year. The selected participants also completed the same questionnaire as the other bilingual groups.

The participants began to acquire Catalan (L2) when they were, on average, 33.7 years old, $SD = 7.4$, and all of them had been school-trained in the L2 from 3 to 6 months, 3 hr per week. Their language experience was strongly marked by the Spanish language: They received their primary, secondary, or/and college education in Spanish, which also was the language they used within the family and other contexts of social interaction (with friends, colleagues, partner, etc.).

When they were asked to rate the frequency of language use for each of their two languages, their mean ratings were: 3.1, $SD = 0.9$ for listening; 4.1, $SD = 1.0$ for speaking; 3.6, $SD = 0.9$ for reading; and 4.4, $SD = 0.8$ for writing (where 1 corresponds to "almost always in Catalan" and 5 corresponds to "almost always in Spanish"). Therefore, they used more Spanish than Catalan in these linguistic abilities, except in the case of listening, where the pattern of language use was similar for both languages. This result is not surprising if we consider that participants are very often exposed to Catalan outside of school in informal situations (watching television, listening to the radio, shopping, etc.).

Participants were also asked to assess their language competence (understanding, speaking, reading, and writing) for both languages. They rated themselves as more competent in Spanish than in Catalan. In the case of Spanish, they rated all abilities

as 5 on a 5-point scale (where 1 is considered a very poor level of competence and 5 is a very good level). In the case of Catalan, participants' mean ratings were 4.1, $SD = 0.6$ for understanding; 2.7, $SD = 0.6$ for speaking; 3.7, $SD = 0.5$ for reading; and 2.6, $SD = 0.7$ for writing.

Materials

A total of 70 word sets were selected as the critical materials of the experiment. Each of the 70 sets included seven word pairs. In all pairs, the first member, which we will refer to as the target word, was always in Catalan (participants' L2) and the second member was a Spanish (participants' L1) word. This L1 word could be a correct translation or one of six false translations. Therefore, each L2 target word could appear under one of seven different conditions that were the following:

1. A translation condition in which the second word of the pair was the correct translation of the first one (e.g., *ruc-burro*, donkey). All the translations were noncognates between Catalan and Spanish.

2. A first semantically related condition (very close pairs) in which the second word of the pair was closely related in meaning to the correct translation (e.g., *ruc-caballo*, horse; see Appendix A for the complete list of stimuli).

3. An unrelated control condition for semantic pairs from condition 2 (very close pairs) in which the second word was completely unrelated to the correct translation (e.g., *ruc-domingo*, Sunday).

4. A second semantically related condition (close pairs) in which the second word of the pair was less similar in meaning to the correct translation than it was in the very close condition (e.g., *ruc-oso*, bear; see Appendix A for the complete list of stimuli).

5. An unrelated control condition for the semantic pairs from condition 4 (close pairs) in which the second word was completely unrelated to the correct translation (e.g., *ruc-sed*, thirst)

6. A form-related condition in which the second word of the pair was a word in the L1 whose translation in the L2 was orthographically similar to the L2 word to be translated (e.g., *ruc-riego*, watering, whose translation in Catalan, *rec*, is similar to the Catalan word *ruc*; see Appendix B for the complete list of stimuli).

The word pairs belonging to this condition were constructed in the same way as Talamas et al. (1999) did when they tested the L2-L1 direction. They designed their materials to reflect the natural errors observed in the classroom: As Talamas et al. pointed out, L2 nonproficient students often confound L2 words that have similar spellings. Thus, the study of the interference produced by L1 words whose translation in L2 is orthographically similar to the L2 word to be translated is the only way to test the interference between similar L2 words in a translation recognition task.

7. An unrelated control condition for the form-related pairs from condition 6 in which the second word was completely unrelated to the correct translation (e.g., *ruc- tinte*, dye).

The conditions that included words that were not correct translations were the focus of interest of the experiment.

The set of semantically related word pairs belonged to different semantic categories (i.e., animals, meals, vegetables, etc.) and the words of each pair were coordinates of the same category. Associative relations between the members of any given pair were avoided. The degree of semantic similarity between word pairs (i.e., very close and close words) was initially established by the authors, based on their own intuitions. The final selection was based on data from a similarity rating task and a feature generation task. These tasks were part of a wider study conducted in

our laboratory (Sánchez-Casas, Ferré, García-Albea, & Guasch, 2006).

In the similarity rating task, we asked a group of 34 first-year psychology students to rate the similarity in meaning of the previously selected word pairs on a scale of 1 (not at all similar) to 9 (exactly the same meaning). Participants rated very close word pairs (e.g., *ruc-caballo*, donkey-horse) as more similar, $\bar{X} = 6.32$, $SD = 0.85$, than those that were less semantically related (i.e., close words: *ruc-oso*, donkey-bear), $\bar{X} = 4.06$, $SD = 0.85$. The difference between the ratings of these two types of word pairs was significant, $t(69) = 14.59$, $p < .01$.

To ensure that very close and close words differed in their degree of similarity in meaning to the target word, a feature generation task was performed. Ninety-three additional first-year psychology students were asked to list features of the things to which the words included in the list referred. Once their responses were analyzed, we obtained a list of features for each word. Together with each feature, we recorded the number of participants who listed it. With these data, we carried out a correspondence analysis and we obtained a spatial representation of the target word, as well as of the very close and close words, and then computed the Euclidian distances between these three types of word. The results showed that words belonging to the close condition were significantly more distant from the target word, $\bar{X} = 1.03$, $SD = 0.15$, than those in the very close condition, $\bar{X} = 0.73$, $SD = 0.21$; $t(69) = -9.56$, $p < .001$.

Finally, to further test our semantically related pairs, we performed a cross-language semantic priming experiment using the above selected materials and a semantic categorization task. In each priming trial, the prime (a word in Catalan) was displayed for 250 ms and, immediately after, the target (a word in Spanish) was presented for 1,000 ms. Participants had to decide whether the target was a concrete or an abstract word. In the experiment, we included three experimental conditions: (a) a very close condition in which the meanings of primes and targets

were very similar; (b) a close condition in which the semantic similarity between primes and targets was lower; and (c) an unrelated condition in which primes and targets were not semantically related. The results showed that the participants' response was faster in the very close and close conditions than in the unrelated controls. Therefore, both very close and close related pairs produced a between-languages facilitation effect. Although the magnitude of this effect was greater for very close words (28 ms) than for close words (23 ms), this difference failed to reach statistical significance (for a more detailed description of the experiment, see Guasch, Ferré, & Sánchez-Casas, 2005).

In sum, the findings of the similarity rating task and the feature generation task constitute clear evidence that our two semantic conditions differed in their degree of meaning similarity. In addition, the results of the priming experiment show that both relations are able to produce a cross-languages facilitation effect. Therefore, it seems that the very close and close selected pairs can be used to study the effects of semantic similarity on bilinguals' word processing.

Following with the experimental design described earlier, related conditions (very close, close, and form related) were compared with unrelated controls. Because it was not possible to match the lexical properties of the words across the three experimental conditions, we did not use an only-control condition, rather we included three sets of control words—one for every one of the experimental conditions. These controls did not have any semantic or form relation with words from their corresponding experimental conditions and were matched as closely as possible in frequency and length to them (see Table 1). Therefore, there was not any significant difference between very close words and their controls either in frequency, $t(138) = 0.03, p > .05$, or length, $t(138) = 0.05$, $p > .05$. Similarly, close words and their controls were well matched in both frequency, $t(138) = -0.04, p > .05$, and length, $t(138) = -0.04$, $p > .05$. Concerning form-related words,

Table 1

Means and standard deviations (in parentheses) of the lexical properties of the words included in the experimental and control conditions

Condition	Frequency	Length
Very close words	16.2 (48.7)	6.5 (1.6)
Control for very close words	15.8 (47.3)	6.4 (1.7)
Close words	13.2 (24.6)	6.3 (1.9)
Control for close words	13.3 (24.5)	6.3 (1.9)
Form-related words	59.2 (183.3)	6.3 (1.9)
Control for form-related words	63.5 (187.8)	6.3 (2.0)

they were not different from their controls in either frequency, $t(138) = -0.1, p > .05$, or length, $t(138) = -0.04, p > .05$.

In addition to the 70 translation sets, 50 correct translation pairs were added as filler items. Thus, in total, there were 60 correct translation pairs and 60 false or incorrect translation pairs. Words from these correct translation pairs were selected from the same semantic categories as the false translation pairs. Finally, 12 practice trials were included at the beginning of the experiment.

Seven different lists of 120 items each (60 false translation pairs and 60 filler translation pairs) were constructed and administered to seven groups of participants. Blocks of 10 items per experimental condition were counterbalanced across the seven lists, such that each item was presented only once to each participant under a single experimental condition, but all participants went through the same experimental conditions with different items across the seven groups.

Procedure and Apparatus

The task used in this experiment was a translation recognition task. In each trial, participants were presented with a word in Catalan (L2) followed by a word in Spanish (L1) and were asked

to decide whether the second word was a correct translation of the first. The participants indicated their decisions by pressing one of two response buttons, using their preferred hand for the "yes" responses. Participants were tested individually in one of the seven versions of the experiment. As the participant pressed a foot-switch connected to the computer, a fixation point appeared on the screen for 500 ms. This was immediately followed by a Catalan word presented for 500 ms. Then the Catalan word disappeared and a Spanish word appeared for 500 ms. Both words were presented in uppercase. Reaction times were recorded to the nearest millisecond from the onset of the second word. The order of presentation of the items was randomized for each participant. The display of the stimuli and recording of reaction times and error percentages were controlled by the DMastr package developed by Forster and Forster (1990).

Results

The data corresponding to incorrect responses were discarded from the analysis. Reaction times that were more than two standard deviations above or below the mean for a given participant in all conditions were trimmed to the appropriate cutoff values to moderate the influence of outliers. Any participant who made an error rate above 15% was replaced. The mean reaction times (RTs) and percentage of errors (%E) across the seven experimental conditions are shown in Table 2.

Translation Data

We performed an analysis of variance (ANOVA) on the reaction times and on the percentage of errors. This analysis revealed that there was a significant effect of the factor "group of participants" on RT, $\text{MinF}'(2, 187) = 29.3$, $p < .01$, and on %E, $\text{MinF}'(2, 230) = 4.5$, $p < .05$.

Table 2

Mean reaction times (in ms) and error rate (in %) across the seven experimental conditions

	Late nonproficient bilinguals		Late proficient bilinguals		Early bilinguals	
Condition	Mean	Error rate	Mean	Error rate	Mean	Error rate
Translation	930	15	710	5	563	6
Very close	1,071	16	855	27	674	20
Control	1,061	9	812	4	627	3
Difference	10	7	43	23	47	17
Close	1,078	11	803	4	640	5
Control	1,055	9	788	3	633	3
Difference	23	2	15	1	7	2
Form	1,101	15	825	6	668	9
Control	1,037	9	784	2	631	4
Difference	64	6	41	4	37	5

Concerning RTs, planned comparisons revealed that there were differences between early and late proficient bilinguals' performances both by participants, $t_1\,(75) = 4.1, p < .01$, and by items, $t_2\,(69) = -7.8, p < .01$. The difference between late proficient and late nonproficient bilinguals also reached statistical significance, $t_1(54) = 4.1$, $p < .01$; $t_2(69) = 6.7$, $p < .01$. The same pattern of differences was obtained between the early and the late nonproficient groups, $t_1(75) = 8.7$, $p < .01$; $t_2(69) = -13.3$, $p < .01$. Therefore, late nonproficient bilinguals were the slowest participants in responding to correct translations, early bilinguals were the quickest ones, and late proficient bilinguals were in between the other two groups.

The data on %E revealed a different pattern of results: There were significant differences between late nonproficient and early bilinguals, $t_1(75) = 3.5$, $p < .01$; $t_2(69) = -3.9$, $p < .01$ as well as between late nonproficient and late proficient bilinguals,

$t_1(54) = 3.0, p < .01; t_2(69) = 3.5, p < .01$. In contrast, there were no differences between early and late proficient participants in the %E committed (both $t < 1$). This last result can be taken as additional evidence of the similar L2 proficiency in early and late proficient bilinguals.

Nontranslation Data

Two ANOVAS were performed: one for the participants' means (collapsing over items) and one for the items' means (collapsing over participants). In these analyses, two factors were included. The first one was "group of participants" with three levels (early, late proficient, and late nonproficient bilinguals), which was a nonrepeated variable in the participants analysis and a repeated variable in the items analysis. The second factor was "type of relation" with three levels (very close, close, and form-related pairs). This last variable, which was obtained by subtracting data belonging to control conditions from data of very close, close, and form-related conditions, was a repeated-measure variable in both the participants and the items analyses.

The ANOVAS performed on the RT revealed that the effect of the type of relation was significant by participants, $F_1(2, 102) = 3.5, p < .05$, but not by items, $F_2(2, 132) = 1.2, p > .05$. Furthermore, the "group of participants" variable did not reach statistical significance either by participants, $F_1(2, 102) = 0.02, p > .05$, or by items, $F_2(2, 132) = 0.2, p > .05$. Finally, we failed to obtain any significant interaction between the two variables, $F_1(4, 204) = 1.5, p > .05; F_2(4, 264) = 0.6, p > .05$.

Concerning the %E, there was a significant interaction between the type of relation and the group of participants, $F_1(4, 204) = 4.7, p < .01$, $F_2(4, 276) = 4.5, p < .01$. In addition, there was an effect of the type of relation that was significant by participants, $F_1(2, 102) = 29.5, p < .001$, and by items, $F_2(2, 138) = 22.3, p < .001$. However, the effect of the group of participants failed to reach statistical significance in both analyses, $F_1(2, 102) = 2.4, p > .05; F_2(2, 138) = 2.5, p > .05$.

The results from the planned comparisons among the three related conditions (very close, close, and form-related pairs) and their corresponding controls are reported separately for each bilingual group in the following subsection.

Early Bilingual Group

Planned comparisons of the RT data were carried out within each of the two word relations. We obtained a significant interference effect (47 ms) for very close words, $t_1(48) = 4.1$, $p < .01$; $t_2(69) = 2.6$, $p < .01$. Similarly, form-related words produced an interference effect of 37 ms that was significant both by participants, $t_1(48) = 4.0$, $p < .01$, and by items, $t_2(69) = 2.5$, $p < .01$. In contrast, the interference effect for the close words (7 ms) failed to reach statistical significance $t_1(48) = 0.8$, $p > .05$; $t_2(69) = 0.4$, $p > .05$. Finally, the semantic interference effect for very close words was not greater than the form interference effect, $t_1(48) = 0.7$, $p > .05$; $t_2(69) = -0.6$, $p > .05$.

The general pattern of results in the planned comparisons performed on the error data was similar to that observed in the reaction time data. Participants made significantly more errors in the very close condition (20%) than in the control condition (3%), $t_1(48) = 7.7$, $p < .01$; $t_2(69) = 5.7$, $p < .01$. The percentage of errors was also greater in the form-related condition (9%) than in the control condition (4%) and the difference reached significance both in the participants analysis, $t_1(48) = 2{,}8$, $p < .01$, and in the items analysis, $t_2(69) = 2.8$, p $< .01$. In addition, there was no significant difference between the %E made in the close condition (5%) in comparison to its control (3%), $t_1(48) = 1.7$, $p > .05$; $t_2(69) = 1.6$, $p > .05$. However, in contrast to the RT data, the magnitude of errors in the very close condition (17) was higher than in the form-related condition (5). Such a difference was statistically significant, $t_1(48) = 4.6$, $p < .01$; $t_2(69) = -3.6$, $p < .05$. This last result indicates a greater interference when words were close in meaning than when they had a similar form.

Late Proficient Bilingual Group

Concerning RTs, late proficient bilinguals showed an interference effect for very close words (43 ms) that was nearly significant when analyzed by participants, $t_1(27) = 2.0, p = .05$, but failed to reach statistical significance when analyzed by items, $t_2(66) = 1.3, p > .05$. In contrast, there was a significant interference effect (41 ms) for the words included in the form-related condition, $t_1(27) = 3.1, p < .01$; $t_2(69) = 2.4, p < .05$. In addition, as in the case of the early participants, we failed to obtain any significant effect in the close condition, $t_1(27) = 1.4, p > .05$; $t_2(69) = 1.0, p > .05$.

The pattern of results obtained with the %E was similar to that of RTs, although it was not exactly the same. The main difference concerns the interference effect obtained in very close words. In contrast to RTs, this effect was clearly significant when we considered the percentage of errors, $t_1(27) = 6.8, p < .01$; $t_2(69) = 5.5, p < .01$, and its magnitude (23) was not different from that obtained in the early participants (17), $t_1(75) = -1.4, p > .05$; $t_2(69) = -1.1, p > .05$. In addition, as in the RT data, we obtained an interference effect in the form-related condition (its magnitude was 4) that was significant both in the participants analysis, $t_1(27) = 2.3, p < .05$, and in the items analysis, $t_2(69) = 2.1, p < .05$. Furthermore, similarly to the results obtained in the early bilingual group, the form interference effect was of a lower magnitude than the interference obtained with very close pairs, $t_1(27) = -4.9, p < .01$; $t_2(69) = -4.0, p < .01$. Finally, as in the case of RTs, there was no significant effect in the close condition, $t_1(27) = 0.6, p > .05$; $t_2(69) = 0.8, p > .05$.

Late Nonproficient Bilingual Group

The same planned comparisons were carried out now for RTs in this group of participants. They only showed a significant form interference effect (64 ms), $t_1(27) = 2.7, p < .01$; $t_2(69) = 2.1, p < .05$. No significant effects were observed either in the very

close, $t_1(27) = 0.4$, $p > .05$; $t_2(69) = 0.6$, $p > .05$, or in the close conditions, $t_1(27) = 1.0$, $p > .05$; $t_2(69) = 1.1$, $p > .05$.

The pattern of errors was similar to that of the RTs regarding the form-related and close conditions. More errors were made in the form-related condition (15%) than in the control condition (9%), and this difference was near significance by participants, $t_1(27) = 1.9$, $p = .06$, and significant by items, $t_2(69) = 2.3$, $p < .05$. As in the RT data, the %E in the close condition did not differ from the one in the control condition, $t_1(27) = 1.2$, $p > .05$; $t_2(69) = 1.3$, $p > .05$. However, in contrast to the RT data, there were significantly more errors in the very close condition (16%) than in the control condition (9%), $t_1(27) = 2.4$, $p < .05$; $t_2(69) = 2.5$, $p < .01$, indicating that strong semantic relations produced some interference in late nonproficient bilinguals' performance even if that interference was not observed in the RT data. Nevertheless, it should be noted that the magnitude of the interference observed in the very close condition in the %E was significantly lower in late nonproficient bilinguals than in both early, $t_1(75) = -3.0$, $p < .01$; $t_2(69) = 2.8$, $p < .01$, and late proficient bilinguals, $t_1(54) = -3.8$, $p < .01$; $t_2(69) = -3.3$, $p < .01$.

Discussion

The aim of the present work was to investigate the developmental aspect of Kroll and Stewart's (1994) RHM model concerning the access to the conceptual store from an L2. We tested, in a translation recognition task, three groups of Spanish-Catalan bilinguals selected according to their level of proficiency and age of L2 acquisition: early bilinguals, late proficient bilinguals, and late nonproficient bilinguals. Concerning reaction times, we obtained a form interference effect in the three groups of participants, whereas we observed clear semantic effects only in early bilinguals. If we consider the error data, we obtained form and semantic interference effects in the three groups of bilinguals. In the two proficient groups (both early and late), the magnitude of the semantic interference effect was greater than that of the

form-related one. This was not the case for late nonproficient participants, whose semantic interference effect was smaller than that obtained in the remaining two groups. Concerning the semantic interference effects observed in the three groups, they were limited to the words with very close meaning.

With respect to early bilinguals, they showed a significant interference effect with very close pairs. Because these participants were very proficient, this result is similar to the findings reported in previous studies (Altarriba & Mathis, 1997; Chen & Ng, 1989; De Groot & Hoeks, 1995; De Groot & Nas, 1991; Ferré et al., 2001; Kroll & Borning, 1987; Talamas et al., 1999) and clearly supports the view that advanced bilinguals' performance is conceptually mediated (Kroll & Stewart, 1994). Additionally, early bilinguals exhibited a significant interference effect with form-related pairs. Although it is not clear why our proficient bilinguals showed evidence of such effect and Talamas et al.'s proficient participants did not, our result is in line with some previous translation recognition studies that have reported that advanced bilinguals are slower to reject words similar in form to the correct translations than unrelated words (e.g., Altarriba & Mathis). According to Talamas et al., the existence of form interference effects in proficient bilinguals is a finding that could be predicted from the RHM because there are studies that have concluded that the connections between lexical representations are not lost when conceptual mediation is achieved (De Groot, 1992; Kroll & Stewart). Our results, which are consistent with this conclusion, clearly suggest that lexical connections remain active even when bilinguals have attained a high proficiency level in the two languages. Furthermore, the pattern of data obtained with the percentage of errors suggests that early bilinguals' performance was more affected by semantic similarity than by formal similarity between words. This finding, which is similar to that reported by Talamas et al., is consistent with the predictions derived from the RHM, suggesting that advanced bilinguals' performance seems to be more dependent on the links between L2 and concepts than on lexical connections between L1 and L2 words.

Nevertheless, it has to be taken into account that the difference between semantic and form interference effects was only obtained in error data, not in reaction times.

A similar pattern of results was obtained with the late proficient group. Their RT data showed a clear interference effect in form-related pairs, suggesting that, as in the case of early bilingual participants, lexical connections remain active in proficient bilinguals. In addition, they showed a higher %E in words very similar in meaning and similar in form to the true translations than in their respective controls. This interference effect in the error data was also greater in semantically related pairs than in words similar in form. This result, together with that obtained in the early bilingual group, suggests that when they are performing bilingual tasks, proficient bilinguals, regardless of their age of L2 acquisition, show clear evidence of conceptual mediation and that, as predicted by the RHM, with increasing L2 proficiency, bilinguals are more sensitive to semantic manipulations than to formal ones. However, it is important to emphasize that whereas in early bilinguals the semantic interference effects were significant in both RTs and %E, in late proficient bilinguals the interference was only clearly observed in %E, not in RTs. These results show that the performance of these two groups is not exactly the same, suggesting that early bilinguals could have a higher sensitivity to semantic manipulations than late proficient bilinguals.

If we consider the performance of the group of late nonproficient bilinguals, we can conclude that our data support, although not entirely, Kroll and Stewart's (1994) RHM model. The clear interference observed with form-related pairs in RTs as well as the lack of a semantic interference effect is consistent with predictions derived from the RHM, and it is also consistent with previous work that has shown that only performance of bilinguals with a certain degree of L2 proficiency is affected by semantic variables (De Groot & Hoeks, 1995; Kroll & Borning, 1987). However, the pattern of errors of these participants show that they were more likely to mistakenly consider as correct translations of pairs of words that were semantically related than those that

were not. This result, which is similar to that obtained by Talamas et al. (1999), provides some support for the claim that performance of nonproficient bilinguals could also be affected by semantic manipulations, as other studies have concluded (Altarriba & Mathis, 1997; Chen, 1990; De Groot & Keijzer, 2000; De Groot & Poot, 1997; Dufour & Kroll, 1995; Ferré et al., 2001; Frenck-Mestre & Prince, 1997).

Although a conceptual mediation in late nonproficient bilinguals was not a prediction initially made from the RHM, we have to consider that the proponents of the model have suggested that, under some circumstances, individuals with a low level of fluency in L2 can be sensitive to semantic variables. On the one hand, Kroll et al. (1998) pointed out the relevance of the context of L2 acquisition on determining the matching between L2 words and the conceptual system. As stated earlier, although our late nonproficient participants are learning L2 in a formal instruction setting, the wide exposure to the L2 in daily life in Catalonia might facilitate the establishment of direct connections between L2 and the conceptual system and thus might contribute to the explanation of why the bilinguals' performance in our study was affected by semantic manipulations. On the other hand, Kroll and Tokowicz (2001) reviewed evidence that suggested that, in comprehension tasks, bilinguals with a low proficiency level could exhibit a performance that indicates that they are able to access semantic information. However, in tasks that require production, evidence of conceptual mediation is less likely to be found in these participants, as they seem to have clear difficulties in the process of lexicalizing concepts into L2 words. Therefore, the particular conditions in our study (the bilinguals' learning context and the type of task employed) might have made it possible to observe effects of the semantic manipulation in the error data on late nonproficient bilinguals' performance that could have not been observed under different circumstances.

If we consider the data of the three groups of bilinguals with respect to conceptual mediation, it seems that both age of acquisition and proficiency could be relevant variables to take

into account, as the clearest semantic interference effects are observed in early bilinguals, who are also very proficient in the two languages. According to our data, proficiency seems to be more determinant than age of acquisition, because the performance of late proficient participants is more similar to that of early bilinguals than to that of the late nonproficient group. To our knowledge, this is the first study that has assessed the effects of both age of L2 acquisition and proficiency in a translation recognition task. The only studies that have investigated the representation and processing of L2 words that have focused on these two variables and whose findings can be relevant to the RHM are those of Kotz (2001), Kotz and Elston-Güttler (2004), and Silverberg and Samuel (2004). The authors of these studies concluded that the RHM should include both age of acquisition and proficiency as relevant variables that could affect the processing of L2 words. Concerning semantic processing, according to Silverberg and Samuel, the main factor modulating semantic priming was age of L2 acquisition. Conversely, the RT data reported by Kotz and Kotz and Elston-Güttler implied that semantic priming is more determined by proficiency than by age of acquisition. Our results are more in agreement with those of Kotz and Kotz and Elston-Güttler than with those of Silverberg and Samuel, as our findings indicate that proficiency seems to be more relevant than age of acquisition in determining the existence of conceptual mediation in bilinguals.

From our point of view, the fact that we have obtained evidence of conceptual mediation in the late proficient group and Silverberg and Samuel (2004) failed to do so could be due to differences between the population of late bilinguals included in both studies: Most of the late proficient bilinguals tested by Silverberg and Samuel learned L2 in a formal instruction setting. Conversely, as can be seen in the description of our late participants, the context in which they learned their L2 has elements of both an immersion environment and a formal instruction setting. Therefore, it could well be that the presence of semantic effects in late bilinguals was modulated by their context of acquisition. This conclusion would be in agreement with Kroll et al.

(1998), who pointed out the relevance of this variable, suggesting that an immersion context would facilitate the attachment of L2 words to the conceptual store and the obtention of semantic effects. However, there is an important methodological difference between Silverberg and Samuel's study and ours, as they used a semantic priming paradigm and a lexical decision task, whereas we employed a translation recognition task. This difference implies that we have to be very cautious in deriving any conclusion from a comparison between the two studies.

There is a last important point to discuss that concerns the effects of the semantic manipulation: We have obtained interference effects with very close pairs, but we have failed to obtain it with close pairs. This result is at odds with Talamas et al.'s study, in which proficient bilinguals exhibited a semantic interference effect with both very close and close related pairs. There are two differences between our study and that of Talamas et al. that might be relevant to consider: Talamas et al. conducted a post hoc analysis separating pairs more or less related in meaning according to similarity ratings only. In contrast, we manipulated the degree of semantic relationship by selecting pairs both through a feature generation task and a similarity rating task and experimentally tested the effects of semantic similarity. The other difference concerns the type of semantic relations. Talamas et al. used a variety of semantic relations, among them words that were semantically associated (e.g., soap and bath) and exemplars of the same semantic category (e.g., garlic and onion). In our study, we only included category coordinates and avoided associative relations; that is, our semantic relationships are defined in terms of their shared features and mere association is excluded. In fact, the literature on semantic priming (e.g., Bueno & Frenck-Mestre, 2002; Frenck-Mestre & Bueno, 1999; Perea & Rosa, 2002; Thompson-Schill, Kurtz, & Gabrieli, 1998) suggests that associated and nonassociated semantically related words can produce different patterns of results. Therefore, the divergences between Talamas et al.'s study and ours might be explained by differences between the materials employed.

Our findings suggest that the degree of similarity in meaning between words can modulate the presence of semantic effects in bilinguals. These findings are consistent with some studies that have found that featural similarity between words is a main factor determining access to semantic memory (e.g., McRae & Boisvert, 1998; Sánchez-Casas et al., 2006; Vigliocco, Vinson, Lewis, & Garrett, 2004). Although the RHM, as initially proposed, cannot account for such data, it could explain them assuming, as other models do, a distributed representation at the conceptual level. One such model is the distributed lexical/conceptual feature model, proposed by Kroll and De Groot (1997). This model incorporates a language-independent lexical-feature level of representation, containing information regarding the form of words, and a conceptual-feature level, where aspects of meaning are represented. In addition to these two levels of representation, they postulate a level of lemma representations that mediates between the other two (see Figure 2).

Although Kroll and De Groot's (1997) model does not specify how words are processed in their model, the way the above

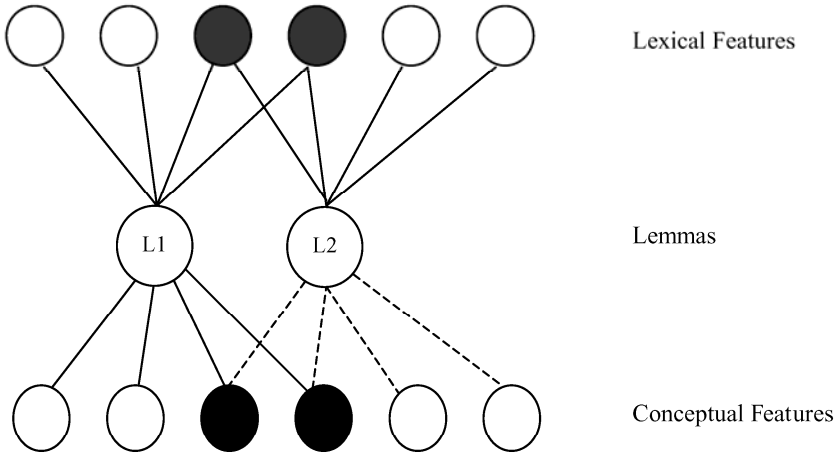

Figure 2. The distributed lexical/conceptual feature model (adapted from Kroll & De Groot, 1997).

effects occur could be as follows. In a translation recognition task performed in the L2-L1 direction, when a word in L2 is presented (e.g., the Catalan word *ruc*), it would activate its corresponding feature nodes at the form level as well as at the conceptual level. Furthermore, because the model assumes that conceptual features are shared between languages, conceptual nodes would be activated whether words are presented in the L1 or the L2. This would explain semantic interference effects between languages. Therefore, when, shortly after the L2 word, the L1 semantically related word is presented, it would activate its corresponding feature nodes at the form level as well as at the conceptual level, but some of them would be already activated as a result of the previously presented word in the L2. This activation would produce semantic interference effects that are not present when concepts corresponding to L1 and L2 nodes do not have any features in common (as in the case of words in the control condition). On the other hand, the activation strength would depend on the degree of meaning overlap (i.e., the number of shared features) between *ruc* (donkey) and the corresponding semantically related words (i.e., *caballo*, horse, and *oso*, bear). This would explain the different pattern of results obtained with very close and close pairs. Finally, the activation strength would also depend on the participants' proficiency level. According to Kroll and De Groot, in early stages of L2 acquisition, the mappings from form to meanings in the L2 would be weak. Therefore, the level of activation of conceptual nodes when a word in the L2 is presented would be higher in proficient than in nonproficient bilinguals. This might explain why a semantic interference effect can be observed in the latter, because the mappings exist, but they are not as consistent as in proficient bilinguals.

In sum, we can conclude that our findings are mostly in agreement with the RHM. They confirm the developmental prediction derived from the model with respect to an increase in semantic effects as bilinguals become more proficient, as suggested by our RT data. However, the present results also suggests that both lexical and conceptual connections are active in all

bilinguals, regardless of their proficiency or age of acquisition, because the pattern of errors exhibited by the three groups of participants shows an effect of both the form and the semantic manipulations. Therefore, it seems that both the lexical and the conceptual routes are available to all bilinguals. At the initial stages of L2 acquisition, the lexical route would be the most important one, but, as proficiency increases, there would be a change and the conceptual route would become more important than the lexical one in determining the performance of bilinguals. The fact that late proficient bilinguals' performance is affected to a lesser extent by the semantic manipulation than that of early bilinguals suggests that the RHM model should consider not only proficiency but also age of acquisition as a factor determining the presence of conceptual mediation in bilinguals' performance. There are other factors that the model should include to account for the pattern of data obtained in the present and other studies: on the one hand, the context in which bilinguals have acquired their L2 and the type of experimental task used (comprehension vs. production), and on the other hand, the degree of meaning similarity between words, as other models that propose a distributed representation at the conceptual level have considered.

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Appendix A

Critical stimuli used in experiments in the semantically related conditions (in alphabetical order) are as follows.

Target	Very close	Close
acelgas (*chards*)	espinacas (*spinach*)	calabaza (*pumpkin*)
alfombra (*carpet*)	esterilla (*small mat*)	parqué (*parquet*)
atún (*tuna*)	lubina (*bass*)	foca (*seal*)
azúcar (*sugar*)	canela (*cinnamon*)	harina (*flour*)
barco (*boat*)	canoa (*canoe*)	avión (*plane*)
barro (*mud*)	tierra (*soil*)	césped (*grass*)
botella (*bottle*)	jarra (*jug*)	plato (*dish*)
búho (*owl*)	águila (*eagle*)	avestruz (*ostrich*)
burro (*donkey*)	caballo (*horse*)	oso (*bear*)
calabacín (*zucchini*)	pepino (*cucumber*)	limón (*lemon*)
calcetines (*socks*)	medias (*tights*)	bañador (*swimsuit*)
calle (*street*)	camino (*path*)	túnel (*tunnel*)
cama (*bed*)	sofá (*sofa*)	mesa (*table*)
cerdo (*pig*)	jabalí (*wild boar*)	cebra (*zebra*)
cerilla (*match*)	mechero (*lighter*)	vela (*candle*)
colchón (*mattress*)	cojín (*cushion*)	cortina (*curtain*)
cordero (*lamb*)	cabra (*goat*)	ciervo (*deer*)
cubo (*bucket*)	barreño (*large bowl*)	escoba (*brush*)
cuchillo (*knife*)	espada (*sword*)	pistola (*gun*)
ensalada (*salad*)	escalivada (*Catalan dish*)	potaje (*hotpot*)
fresa (*strawberry*)	cereza (*cherry*)	nuez (*walnut*)
garbanzos (*chickpeas*)	lentejas (*lentils*)	fideos (*noodles*)
gorrión (*sparrow*)	golondrina (*swallow*)	ardilla (*squirrel*)
guisante (*pea*)	judía (*bean*)	patata (*potato*)
gusano (*worm*)	anguila (*eel)*	abeja (*bee*)
hielo (*ice*)	granizo (*hailstone*)	niebla (*fog*)
hilo (*thread*)	lana (*wool*)	cadena (*chain*)
jamón (*ham*)	salchichón (*salami*)	tortilla (*omelette*)

Appendix A (continued)

Target	Very close	Close
lagartija (*small lizard*)	lagarto (*lizard*)	ratón (*mouse*)
lata (*tin*)	bote (*can*)	bandeja (*tray*)
lavadora (*washing*)	lavaplatos (*dishwasher*)	horno (*oven*)
lechuga (*lettuce*)	col (*cabbage*)	champiñón (*mushroom*)
lluvia (*rain*)	nieve (*snow*)	tornado (*tornado*)
madera (*wood*)	corcho (*cork bark*)	cemento (*concrete*)
manzana (*apple*)	naranja (*orange*)	coliflor (*cauliflower*)
mariposa (*butterfly*)	polilla (*moth*)	pavo (*turkey*)
mejillón (*mussel*)	almeja (*clam*)	ballena (*whale*)
melocotón (*peach*)	ciruela (*plum*)	nabo (*root vegetable*)
merluza (*hake*)	lenguado (*sole*)	sapo (*toad*)
mono (*monkey*)	gorila (*gorilla*)	vaca (*cow*)
muela (*tooth*)	colmillo (*fang*)	cuerno (*horn*)
muñeca (*doll*)	marioneta (*marionette*)	puzzle (*puzzle*)
naranjo (*orange tree*)	limonero (*lemon tree*)	rosal (*rosebush*)
paloma (*pigeon*)	gaviota (*seagull*)	delfín (*dolphin*)
pañuelo (*handkerchief*)	bufanda (*scarf*)	guantes (*gloves*)
pato (*duck*)	ganso (*goose*)	tortuga (*turtle*)
peca (*freckle*)	verruga (*wart*)	grano (*spot*)
pendiente (*earring*)	anillo (*ring*)	reloj (*clock*)
perejil (*parsley*)	tomillo (*thyme*)	vainilla (*vanilla*)
perro (*dog*)	hiena (*hyena*)	buey (*ox*)
pimiento (*pepper*)	berenjena (*eggplant*)	níspero (*loquat*)
pulpo (*octopus*)	calamar (*squid*)	salmón (*salmon*)
queso (*cheese*)	cuajada (*curd*)	flan (*crème caramel*)
rana (*frog*)	salamandra (*salamander*)	serpiente (*snake*)
rodilla (*knee*)	codo (*elbow*)	ojo (*eye*)
sábana (*sheet*)	colcha (*bedspread*)	tapete (*runner*)
servilleta (*napkin*)	mantel (*tablecloth*)	manta (*blanket*)
silla (*chair*)	butaca (*armchair*)	estantería (*shelves*)
sombrero (*hat*)	gorra (*cap*)	pantalones (*trousers*)
techo (*ceiling*)	tejado (*roof*)	pasillo (*corridor*)
tiburón (*shark*)	orca (*killer whale*)	cangrejo (*crab*)
tijeras (*scissors*)	alicates (*pliers*)	destornillador (*screwdriver*)
tormenta (*storm*)	huracán (*hurricane*)	terremoto (*earthquake*)
trigo (*wheat*)	centeno (*rye*)	avellana (*hazelnut*)
uva (*grape*)	pasas (*raisins*)	remolacha (*beetroot*)
vaso (*glass*)	taza (*cup*)	fuente (*serving dish*)
ventana (*window*)	puerta (*door*)	armario (*wardrobe*)
yegua (*mare*)	mula (*mule*)	elefante (*elephant*)
zanahoria (*carrot*)	rábano (*radish*)	albaricoque (*apricot*)
zumo (*juice*)	batido (*milk shake*)	aceite (*oil*)

Appendix B

Critical stimuli used in experiments in the form-related condition (in alphabetical order). L2 translations of both target and form-related pairs are shown with the aim of clarifying the form relation between words through L2.

Target	Form	Target (L2)	Form (L2)
acelgas (*chards*)	frías (*cold*)	bledes	fredes
alfombra (*carpet*)	califa (*caliph*)	catifa	califa
atún (*tuna*)	telaraña (*spider's web*)	tonyina	teranyina
azúcar (*sugar*)	suegro (*father-in-law*)	sucre	sogre
barco (*boat*)	vajilla (*tableware*)	vaixell	vaixella
barro (*mud*)	sangre (*blood*)	fang	sang
botella (*bottle*)	anchura (*width*)	ampolla	amplada
búho (*owl*)	músculo (*muscle*)	mussol	múscul
burro (*donkey*)	riego (*irrigation*)	ruc	rec
calabacín (*zucchini*)	carbonoso (*carbonaceous*)	carbassó	carbonós
calcetines (*socks*)	medios (*media*)	mitjons	mitjans
calle (*street*)	cerezo (*cherry tree*)	carrer	cirerer
cama (*bed*)	leche (*milk*)	llit	llet
cerdo (*pig*)	parque (*park*)	porc	parc
cerilla (*match*)	luna (*moon*)	llumí	lluna
colchón (*mattress*)	catalanes (*catalans*)	matalàs	catalans
cordero (*lamb*)	nunca (*never*)	xai	mai
cubo (*bucket*)	gallego (*Galician*)	galleda	gallec
cuchillo (*knife*)	mueca (*grimace*)	ganivet	ganyota
ensalada (*salad*)	espabilada (*astute*)	amanida	eixerida
fresa (*strawberry*)	madeja (*skein*)	maduixa	madeixa
garbanzos (*chickpeas*)	pezón (*nipple*)	cigrons	mugró
gorrión (*sparrow*)	hablar (*to speak*)	pardal	parlar
guisante (*pea*)	pesado (*heavy*)	pèsol	pesat
gusano (*worm*)	cola (*tail*)	cuc	cua
hielo (*ice*)	cielo (*heaven*)	gel	cel
hilo (*thread*)	hijo (*son*)	fil	fill
jamón (*ham*)	peligro (*danger*)	pernil	perill
lagartija (*small lizard*)	tramontana (*north wind*)	sargantana	tramontana
lata (*tin*)	larga (*long*)	llauna	llarga
lavadora (*washing*)	montadora (*assembler*)	rentadora	muntadora
lechuga (*lettuce*)	encanto (*charm*)	enciam	encant
lluvia (*rain*)	cerda (*sow*)	pluja	truja
madera (*wood*)	oscura (*dark*)	fusta	fosca
manzana (*apple*)	pata (*leg*)	poma	pota
mariposa (*butterfly*)	papelina (*drug packet*)	papallona	papelina
mejillón (*mussel*)	hombro (*shoulder*)	musclo	muscle

Appendix B (continued)

Target	Form	Target (L2)	Form (L2)
melocotón (*peach*)	préstamo (*loan*)	préssec	préstec
merluza (*hake*)	lazo (*lasso*)	lluç	llaç
mono (*monkey*)	majo (*nice*)	mico	maco
muela (*tooth*)	quejar (*to complain*)	queixal	queixar
muñeca (*doll*)	herramienta (*tool*)	nina	eina
naranjo (*orange tree*)	tabernero (*barkeeper*)	taronger	taverner
paloma (*pigeon*)	color (*color*)	colom	color
pañuelo (*handkerchief*)	mirador (*balcony*)	mocador	mirador
pato (*duck*)	ir (*to go*)	ànec	anar
peca (*freckle*)	higo (*fig*)	piga	figa
pendiente (*earring*)	llegada (*arrival*)	arracada	arribada
perejil (*parsley*)	juramento (*vow*)	julivert	jurament
perro (*dog*)	cuerpo (*body*)	gos	cos
pimiento (*pepper*)	rebrote (*sprout*)	pebrot	rebrot
pulpo (*octopus*)	pozo (*well*)	pop	pou
queso (*cheese*)	follaje (*foliage*)	formatge	fullatge
rana (*frog*)	granjero (*farmer*)	granota	granger
rodilla (*knee*)	yerno (*son-in-law*)	genoll	gendre
sábana (*sheet*)	tirar (*to pull*)	llençol	llençar
servilleta (*napkin*)	medallón (*medallion*)	tovalló	medalló
silla (*chair*)	cadena (*chain*)	cadira	cadena
sombrero (*hat*)	barras (*bars*)	barret	barres
techo (*ceiling*)	rostro (*face*)	sostre	rostre
tiburón (*shark*)	tablón (*board*)	tauró	tauló
tijeras (*scissors*)	estiradas (*stretched*)	estisores	estirades
tormenta (*storm*)	temporero (*temporary*)	tempesta	temporer
trigo (*wheat*)	azul (*blue*)	blat	blau
uva (*grape*)	rayo (*thunderbolt*)	raïm	raig
vaso (*glass*)	todo (*all*)	got	tot
ventana (*window*)	siniestra (*sinister*)	finestra	sinistra
yegua (*mare*)	fuga (*escape*)	euga	fuga
zanahoria (*carrot*)	pastorcilla (*little shepherdess*)	pastanaga	pastoreta
zumo (*juice*)	saco (*sack*)	suc	sac

ARTÍCULO III

Guasch, M., Sánchez-Casas, R., Ferré, P. y García-Albea, J. E.

Translation performance of beginning, intermediate and proficient Spanish-Catalan bilinguals: Effects of form and semantic relations

The Mental Lexicon, 3, 289–308
(2008)

Artículo 3

Guasch, M., Sánchez-Casas, R., Ferré, P. y García-Albea, J. E. (2008). Translation performance of beginning, intermediate and proficient Spanish-Catalan bilinguals: Effects of form and semantic relations. *The Mental Lexicon, 3*, 289–308.

Objetivos específicos

- Dados los resultados de los experimentos del artículo anterior, estudiar con más detalle el papel del nivel de competencia en la segunda lengua en el desarrollo de las conexiones léxicas y conceptuales que se establecen durante el proceso de adquisición de la L2, empleando una gradación de tres niveles distintos de competencia.

- Poner a prueba las predicciones del Modelo Jerárquico Revisado en cuanto al mayor uso de la ruta léxica por parte de los bilingües poco competentes en su segunda lengua, y un mayor uso de las conexiones directas con el nivel conceptual en el caso de los bilingües muy competentes en su segunda lengua.

- Poner a prueba el Modelo de Rasgos Distribuidos explorando la propuesta de que el rendimiento de los bilingües puede verse afectado por el grado de relación semántica entre una falsa traducción y la traducción correcta.

Predicciones

De nuevo esperaríamos confirmar las predicciones del MJR, observando una mayor influencia de las manipulaciones formales que semánticas en los participantes con un menor nivel de competencia, y lo opuesto (i. e.: mayor influencia semántica que formal) en los dos

grupos de bilingües más competentes. Respecto a la interferencia de forma, con la evidencia del estudio anterior se esperaría que se diera en los tres grupos de participantes, aunque en los participantes menos competentes estos efectos podrían ser mayores que en los otros dos grupos.

También comprobaremos si se replican los resultados del estudio anterior en el que sólo se observó interferencia semántica en la condición de relación muy cercana. Aunque nuestra evidencia previa mostró que la interferencia semántica no se producía con las relaciones cercanas, desde el MRD esperaríamos interferencia en ambos grados de relación semántica, aunque de menor magnitud en las palabras menos relacionadas.

Resumen

El interés general del siguiente artículo fue el de estudiar con mayor detalle la influencia del nivel de competencia en la L2, en el desarrollo de las conexiones léxicas y conceptuales en el proceso de adquisición de la segunda lengua, puesto que en el anterior estudio se puso de manifiesto la relevancia de dicha variable.

Para abordar este objetivo se estudiaron tres grupos de bilingües que diferían en su nivel de competencia en catalán (L2): un grupo de principiantes, otro de intermedios y un tercer grupo de bilingües competentes. La tarea, las condiciones experimentales y el procedimiento empleados fueron los mismos que los expuestos en el artículo anterior, excepto que en este caso el tiempo de presentación de las palabras fue algo mayor (para facilitar así la participación de los principiantes). Los materiales semánticamente relacionados (en las condiciones muy cercana y cercana) también fueron los mismos que los utilizados en el artículo previo.

El grupo de bilingües principiantes mostró claros efectos de interferencia cuando las palabras estaban relacionadas en la forma, pero no cuando lo estaban en el significado. En cambio, los otros dos grupos (bilingües intermedios y competentes) se vieron influidos en su ejecución además de por la relación formal, por la relación semántica muy cercana.

En conclusión, el papel de las relaciones de forma entre palabras no parece depender del nivel de competencia en la segunda lengua, ya que los tres grupos de bilingües mostraron efectos de interferencia de una magnitud similar. En cambio, el nivel de competencia en la segunda lengua sí modularía la sensibilidad a la manipulación semántica, sugiriendo que sería necesario cierto nivel mínimo de competencia para que se produjera interferencia. Este nivel mínimo se daría muy pronto en el proceso de aprendizaje, ya que en niveles intermedios ya sería posible el acceso al nivel conceptual directamente desde la L2.

Respecto al grado de relación semántica, igual que en el estudio anterior se confirma que el grado de relación entre palabras modula la magnitud de la interferencia producida por las falsas traducciones relacionadas en el significado, ya que se observaron efectos con las palabras con una relación muy cercana pero no con las de relación cercana.

Translation performance of beginning, intermediate and proficient Spanish-Catalan bilinguals

Effects of form and semantic relations

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This study explores how proficiency in a second language determines the way that lexical and semantic representations are functionally connected in bilingual memory by testing three groups of participants (beginning and intermediate Spanish-Catalan learners and highly proficient bilinguals). The experiment reported examines how form and semantic manipulations affect the performance of these groups in a translation recognition task using three types of word relations (very close and close semantically related word pairs and form-related pairs). The results reveal that form manipulation affects the performance of the three participant groups, whereas the influence of semantic relations depends on the participants' level of proficiency. Results are discussed within the framework of the Revised Hierarchical Model (Kroll & Stewart, 1994).

Keywords: bilingual memory, Revised Hierarchical Model, level of proficiency, translation recognition, interference effect, semantic similarity, form similarity, second language acquisition

During the last two decades, many studies have addressed the issue of how lexical and semantic representations are functionally connected in bilingual memory (see, e.g., Kroll & De Groot, 2005, for a review). However, fewer studies have focused on how these connections are established in the process of learning a second language. As we will see later, it has been proposed that lexical and semantic connections between the first (L1) and the second language (L2) change during the learning process of L2, and there is evidence that suggests that one of the variables responsible for such a change is the level of proficiency (e.g., Kroll & Sholl, 1992; Kroll & Stewart, 1994). The general aim of the current study is to shed some light

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on how proficiency in L2 can affect the way that lexical (word form) and semantic representations (word meaning) are interconnected across languages. Such a question is of a special relevance to the theme of this special issue, since it examines the relation between L2 proficiency (with learners at different acquisition stages of L2) and word representations between languages, focusing directly on the interface between learning and representation.

In order to answer the question of how lexical and semantic connections are developed during the process of acquiring an L2, studies have generally manipulated the form and meaning relationships between words from two languages and then examined the effects of such manipulations on the performance of both proficient and non-proficient bilinguals in different comprehension tasks (e.g., Altarriba & Mathis, 1997; De Groot & Hoeks, 1995; De Groot & Poot, 1997; Ferré, Sánchez-Casas, & García, 2001; Ferré, Sánchez-Casas, & Guasch, 2006; Kroll & Sholl, 1992; Kroll & Tokowicz, 2001; Sunderman & Kroll, 2006; Talamas, Kroll, & Dufour, 1999). Although the evidence from these studies suggests that factors such as L2 proficiency, age of L2 acquisition, or the context in which the L2 is acquired can have a role in determining the nature of the connections between the two languages in the case of the learner of a second language, the results are not always consistent. For instance, while some lexical decision studies have shown that age of acquisition modulates the pattern of between-language form and semantic priming effects (e.g., Silverberg & Samuel, 2004), others have suggested that both age of acquisition and proficiency in L2 should be taken into account when explaining how L1 and L2 words are connected (e.g., Kotz, 2001; Kotz & Elston-Güttler, 2004). Similarly, when the effects of proficiency have been examined using a translation recognition task, studies have not always revealed the same pattern of results. Some studies have found that the degree of form and semantic cross-language effects vary as a function of proficiency in L2 (e.g., Sunderman & Kroll, 2006; Talamas et al., 1999), while others have found both form and semantic effects with proficient bilinguals but only form effects when non-proficient bilinguals are examined (e.g., Ferré et al., 2006). However, there are also studies that have provided evidence that the extent to which word relations across-languages have an effect in proficient and non-proficient bilinguals depends on the type of form and semantic manipulation between L1 and L2 words (e.g., Linck, Kroll, & Sunderman, 2007; Sunderman & Kroll, 2006). The present study aims at elucidating some of the differential patterns reported in the literature by examining in more detail the influence of L2 proficiency in the translation recognition performance of highly proficient Spanish-Catalan bilinguals and learners at different stages of learning Catalan as an L2.

One of the models that has most explicitly proposed how L2 proficiency affects the way that L1 and L2 lexical and semantic connections are established

during the process of learning a second language is the Revised Hierarchical Model (RHM) (Kroll & Stewart, 1994). According to the RHM, there are separate lexical representations for words from L1 and L2 but a common semantic/conceptual representational system for both languages. The model also assumes that lexical representations from the two languages are connected to the semantic/conceptual system but that the strength of these connections varies as a function of language direction and proficiency in L2. In particular, the model suggests that at the first stages of L2 learning, the connections between L2 words and the corresponding semantic/conceptual representations are very weak, and thus, access to these representations from L2 is mediated via L1. As proficiency increases, the connections between L2 words and the semantic/conceptual system would develop and be strengthened and direct access to this system could be achieved from L2.

Given these assumptions, the RHM model makes different predictions regarding the effects that form and semantic across-languages manipulations will have in bilingual performance, depending on the level of proficiency in L2. In particular, the model predicts that proficient bilinguals would be more affected by semantic than form variables in tasks that require access to the semantic/conceptual system from L2 words, since they can gain access directly to the corresponding semantic/conceptual representation. On the contrary, non-proficient L2 learners would show the opposite pattern of results. That is, they would be more influenced by form than by semantic manipulations across-languages given that L2-L1 lexical connections are stronger than the connections between L2 and the semantic/conceptual system.

The RHM predictions regarding the effects of L2 proficiency have been tested in studies using a translation recognition task (De Groot, 1992) where English-dominant participants with different levels of proficiency in Spanish (L2) were presented with a word in one language followed by a word in the other language and had to decide whether the second word was the correct translation of the first one. These studies included sets of trials which consisted of correct translations (e.g., *cara-face*) as well as distractor trials. These distractor trials could be non-translation pairs related in form (e.g., *cara-fact*) or in meaning (e.g., *cara-head*) across languages. The distractor non-translation pairs were then compared with matched unrelated non-translation controls in order to determine the extent to which form and semantic relations across languages slowed the translation recognition times, in other words, whether an interference effect was observed in the distractor non-translation pairs. In general, the results from these studies confirmed the predictions derived from the RHM. That is, less proficient L2 learners were more sensitive to form than to semantic manipulations and thus showed more form than semantic interference effects, while the opposite was true for more proficient learners (e.g., Linck et al., 2007; Sunderman & Kroll, 2006; Talamas et al. 1999).

Using the same procedure as in the above mentioned studies, Ferré et al. (2006), also compared form and semantic interference effects with Spanish learners of Catalan in a translation recognition task. The set of semantically related pairs that Ferré et al. used was taken from a previous study by Sánchez-Casas, Ferré, García-Albea, and Guasch (2006). These authors estimated the degree of semantic similarity between word pairs using two procedures: a feature generation task and a similarity judgment task. On the basis of both similarity ratings and a measure of semantic distance that takes into account the number of shared features between two words, Sánchez-Casas et al. classified word pairs as being either very closely related in meaning (e.g., *burro – caballo* 'donkey – horse') or closely related (e.g., *burro – oso* 'donkey – bear'). The two words in each pair were always members of the same semantic category (i.e., semantic coordinates).

The general pattern of results obtained by Ferré et al. (2006), with the above set of semantically related pairs, was along the same line as that reported previously. Similar to findings of other studies, Spanish-Catalan proficient bilinguals were found to be more influenced by meaning than by form relations, and this was true regardless of age of acquisition (early vs. late). Likewise, Ferré et al. found that the learners were also sensitive to form relations across languages. However, several differences with respect to previous findings emerged. On the one hand, in Ferré et al.'s study, the semantic manipulation had only an effect in proficient Spanish-Catalan bilinguals when the two words were very closely related in meaning (e.g., *ruc – caballo* 'donkey – horse' produced an interference effect, but *ruc – oso* 'donkey – bear' did not). This contrasts to previous studies that have reported effects with meaning relations with both more and less semantically related words (e.g., Linck et al., 2007; Sunderman & Kroll, 2006; Talamas et al. 1999). On the other hand, Ferré et al.'s results also differ from previous findings regarding the effects of the semantic manipulation in their group of learners (e.g., Linck et al., 2007; Sunderman & Kroll, 2006; Talamas et al. 1999) since they failed to be sensitive to meaning relations even when these were semantically very close.

How can we account for the differences between Ferré et al.'s (2006) results and those reported in similar translation recognition studies? Ferré et al.'s study differs in two respects. The first difference concerns the level of proficiency in L2 of the learners. In the case of Ferré et al., the learners seem to have less proficiency in L2 than the learners who participated in previous studies. This might explain why they did not show a semantic interference effect on the translation recognition times while the learners in the other studies did. The learners were at a very early stage in the acquisition of their L2 and, as the RHM predicts, they were not able to gain access directly to the semantic/conceptual system from the L2 words. If this is the case, it would suggest that only very early beginners are not sensitive to semantic manipulations, perhaps due to processing limitations. The primary goal of the

present study was to test this possibility by examining the performance of three groups of participants: a group of highly proficient Spanish-Catalan bilinguals and two groups of Spanish learners of Catalan, one group with a level of proficiency similar to that of Ferré et al.'s (beginners) and another group with a higher level of L2 proficiency (intermediates), more similar to that examined in prior studies (e.g., Sunderman & Kroll, 2006; Talamas et al., 1999).

Proficiency in L2, however, could not account by itself for all the differences in the pattern of results. Ferré et al.'s (2006) bilingual participants were very proficient in their L2, and although they showed semantic interference with very close semantic relations (*donkey – horse*), they failed to do so with close semantic relations (*donkey – bear*). Conversely, Sunderman and Kroll's (2006) participants, despite being clearly less proficient in L2 than Ferré et al.'s bilinguals, showed semantic interference using distractors that were both less and more semantically related (see also Talamas et al., 1999). This result led us to consider a second important difference between the above studies related to the type of semantic relation tested. The distinction of relevance here is the one between semantically and associatively related words. Semantic relations reflect similarity or overlap in meaning of the two words (e.g., *whale – dolphin*). Associative relations, on the other hand, are assumed to reflect the co-occurrence of two words in language use (e.g., *spider – web*). Word associates are established using normative descriptions of the probability that one word will call to mind a second word that may or may not be semantically similar (e.g., *radish – beet vs. coat – rack*) (see Ferrand & New, 2003). The abovementioned translation recognition studies used mostly associative semantic relations, but this was not the case in Ferré et al.'s study in which only purely semantically related words (i.e., only non-associatively related semantic coordinates, e.g., *donkey – horse*) were used. Thus, it is also possible that the type of semantic relation may be important in determining the pattern of interference effects and that semantic relation interacts with level of proficiency in L2. That is, L2 learners may be sensitive to semantic relations that are associative in nature, regardless of their level of proficiency and how close these associative relations are, as Sunderman and Kroll (2006) have reported. However, the effects of purely semantically related words might depend on L2 proficiency and the degree to which the two words are semantically related, as Ferré et al.'s findings suggest.

The possibility that the level of proficiency in L2 modulates the effects of non-associative semantic relations can also be examined by comparing the translation recognition performance of our three groups of participants (beginners, intermediates, and highly proficient bilinguals). To test this possibility, in the present study, we have used the same set of semantically related word pairs as those used by Ferré et al. (2006; i.e., very close and close). If the effects of purely semantic relations, in contrast to associative relations, vary as a function of proficiency, learners at the

very early stages of L2 acquisition (i.e., beginners) should not show any semantic interference effect. On the contrary, in the case of intermediate learners, as well as of highly proficient bilinguals, evidence of these effects should be expected. Moreover, if we replicate Ferré et al.'s pattern of results, semantic interference should be observed only when the words are very closely related.

Regarding form relations, the present study also includes a condition where the non-equivalent translations are related in form across languages (e.g., *ruc-berro*, where *berro*, 'watercress,' is a translation neighbor of *burro*, 'donkey'). Following Ferré et al.'s (2006) findings, L2 proficiency is not expected to influence form sensitivity, and thus, all participants should show interference with form related word pairs. However, since according to our predictions, beginning L2 learners would rely on lexical connections when processing L2 words, it also might be possible that they show more form interference than both the intermediate and proficient bilingual groups. In the experiment reported below, we tested predictions concerning both the effects of form and purely semantic relations in the three groups of participants.

Method

Participants

The participants in the current experiment lived in Tarragona (Catalonia) at the time of the experiment. Spanish and Catalan are both official languages in Catalonia and are used on a daily basis (school, university, shops, TV, radio, written press, etc.). Thus, apart from learning Catalan (L2) in a formal instructional setting (i.e., taking Catalan courses at school), participants from the non-proficient groups were also immersed in a context where this language was commonly used.

Beginning language learners. Twenty-two students from the 'Centre de Normalització Lingüística de Cambrils' (an official center specialized in teaching Catalan in Tarragona) formed part of this group. They were, on average, 33.1 ($SD = 10.7$) years old. They were all native speakers of Spanish and had begun to attend to Catalan courses, on average, one half of a year ($SD = 0.7$) prior to the experiment and were still receiving formal instruction in Catalan at the time of the experiment.

Participants were asked to complete a detailed questionnaire in order to collect information regarding their language history (e.g., languages spoken at home, at the school, frequency of language use, level of proficiency in both Spanish and Catalan, etc.). The data from the questionnaire revealed that the participants from this group received their primary and secondary education in Spanish, used this

Table 1. Mean Frequency of Language Use and SD for the Three Groups of Participants

Skills	Beginning language learners		Intermediate language learners		Proficient bilinguals	
	Mean	SD	Mean	SD	Mean	SD
Listening	3.0	0.9	3.7	0.7	2.8	1.0
Speaking	4.3	0.7	4.3	0.6	2.8	1.5
Reading	3.9	0.9	3.2	1.2	3.2	0.9
Writing	4.6	0.6	4.5	0.8	2.7	1.1

Note. The scores were obtained from a 5-point scale comparing the frequency of use of Spanish versus Catalan for each skill, where 1 = almost always in Catalan, 2 = mostly in Catalan, 3 = the same in Catalan and Spanish, 4 = mostly in Spanish and 5 = almost always in Spanish.

language in their social interactions, and chose it as their preferred language in both comprehension and production.

Table 1 shows the frequency of language use for Spanish and Catalan for this group of participants. As can be seen, they used more Spanish than Catalan except for listening, where the frequency was the same for both languages.

Table 2 shows the participants' ratings of their level of proficiency in both languages. They rated themselves as more competent in Spanish than in Catalan for the four linguistic skills (listening, speaking, reading, and writing).

Intermediate language learners. Sixteen students from the 'Centre de Normalització Lingüística de Cambrils' were selected for this group. Their mean age was 40.1 years ($SD = 9.8$). As with the beginning language learners, their first language

Table 2. Mean Level of Language Proficiency and SD in the Four Linguistic Skills for the Three Groups of Participants in Spanish and Catalan

Skills	Beginning language learners		Intermediate language learners		Proficient bilinguals	
	Mean	SD	Mean	SD	Mean	SD
Spanish						
Listening	5.0	0.0	4.9	0.3	4.8	0.6
Speaking	5.0	0.0	4.8	0.4	4.4	0.8
Reading	5.0	0.0	4.9	0.3	4.7	0.7
Writing	4.8	0.4	4.8	0.4	4.4	0.7
Catalan						
Listening	3.8	0.5	4.2	0.4	4.8	0.6
Speaking	2.4	0.8	3.0	0.4	4.4	0.8
Reading	3.7	0.5	3.9	0.5	4.7	0.7
Writing	2.4	1.0	2.7	0.7	4.3	0.8

Note. The scores were obtained from a 5-point scale where 1 = very poor, 2 = poor, 3 = average, 4 = good and 5 = very good.

(L1) was Spanish. This group began acquiring Catalan, on average, 2.2 years (*SD* = 2.3) before the experiment. At the time of the experiment, they had been attending Catalan courses, on average, for 12.1 months (*SD* = 11.4) and were still receiving formal instruction in Catalan.

They were also asked to complete the same language questionnaire as the beginning language learners. Similar to the case of the beginning language learners, the intermediate language learners had received their primary and secondary education in Spanish and used this language most often in their social interactions. Concerning frequency of language use (see Table 1), participants used Spanish more frequently than Catalan in all contexts. They also rated their level of proficiency in both languages. As Table 2 shows, their ratings were higher in Spanish than in Catalan in the four linguistic skills and considered themselves more proficient in Catalan than did the beginning language learners.

If we compare the ratings of the beginning and intermediate learners, one can see that their scores on frequency of language use are very close (see Table 1). This is not surprising if one considers, on the one hand, that Spanish and Catalan, as mentioned earlier, are used regularly in everyday life, both in the spoken and written domain. On the other hand, one must take into account that late learners of Catalan, even highly proficient ones will always use their first more than their second language. In light of these considerations, it was expected that our two leaner groups were using Spanish more than Catalan, regardless of their level of proficiency in L2.

Proficient bilinguals. Seventy-five Psychology students from the University Rovira i Virgili (in Tarragona), whose mean age was 20.9 years (*SD* = 3.8), participated in this experiment. They were all born in Catalonia and had acquired both languages during childhood.

They were asked to complete the same language questionnaire as the other two groups. They also had received their primary, secondary, and university education in both languages. The questionnaire data also showed that they used the two languages to a similar extent in their everyday life (see Table 1) and rated themselves as highly proficient in the four skills in both Spanish and Catalan (see Table 2). As the data show, this group of participants was very balanced.

The proficient bilingual group included a larger number of participants than that of the beginning and intermediate groups due to two reasons. First, although other late learners of Catalan were available to participate in the study, Spanish was not their first language. Second, many L1 Spanish speakers immersed in Catalan in this region come to achieve a level of proficiency in Catalan that was higher than the level that was required to be a participant in the beginner or the intermediate learner groups.

Materials

A total of 70 word sets were selected as the critical materials of the experiment. Each set consisted of seven word pairs. The first word of each pair was always in Catalan (L2). The second one was always in Spanish (L1). The L1 word could be a correct translation of the corresponding L2 word or one of six false translations. In total, there were 7 experimental conditions with 10 stimuli each. The conditions were the following:

1. Translation condition: the second word of the pair was the correct translation of the first one (e.g., *ruc* – *burro* 'donkey – donkey').
2. Very close semantic condition: the second word of the pair was very similar in meaning to the first one (e.g., *ruc* – *caballo* 'donkey – horse').
3. Control condition for condition 2: the second word of the pair was completely unrelated either in form or in meaning to the correct translation (e.g., *ruc* – *domingo* 'donkey – Sunday').
4. Close semantic condition: the second word of the pair was related in meaning to the first one, although less than in Condition 2 (e.g., *ruc* – *oso* 'donkey – bear').
5. Control condition for condition 4: the second word of the pair was completely unrelated either in form or in meaning to the correct translation (e.g., *ruc* – *sed* 'donkey – thirst').
6. Form condition: the second word of the pair was orthographically similar to the correct translation of the first word (the so-called translation neighbor's e.g., *ruc* – *berro* 'donkey – watercress' where *burro* would be the correct translation of *ruc*).
7. Control condition for condition 6: the second word of the pair was completely unrelated either in form or in meaning to the correct translation (e.g., *ruc* – *lejía* 'donkey – bleach').

The word pairs from the very close and the close semantic conditions (conditions 2 and 4) were the same as those used by Ferré et al. (2006). The two measures of their degree of semantic similarity (i.e., semantic distance and similarity ratings) were provided in the study by Sánchez-Casas et al. (2006). In particular, word pairs with very close semantic relations had an average semantic distance of only 0.7 ($SD = 0.2$), and a mean of semantic similarity ratings of 6.9 ($SD = 0.12$) (in a scale from 1 to 9). In contrast, the average semantic distance between the word pairs with close semantic relationship was 1.0 ($SD = 0.2$), and the mean of the semantic similarity ratings was 4.07 ($SD = 0.71$). We also computed a measure of the degree of similarity between the translation neighbors in the form-related condition using an algorithm described by Van Orden (1987) that provides an objective

measure of orthographic similarity and has been used extensively in prior research (see Schwartz, Kroll, & Diaz, 2007 for details). The average orthographic similarity of our form-related pairs was 0.65 ($SD = 0.1$).

Words in the control conditions were always matched in length (in number of letters) and frequency (Davis & Perea, 2005) to the words from the corresponding experimental conditions. The matching in both variables was done individually for each of the words, that is, for each critical word, an unrelated word with equal (or very similar) length and frequency was selected to serve as its control.

An additional set of 50 filler translation pairs were added in order to maintain the same number of translation and non-translation pairs. Thus, in total, there were 60 correct translation pairs ('yes' response) and 60 false translation pairs ('no' response), the latter being the focus of interest of the experiment. The different conditions were counterbalanced across seven lists such that each participant only saw each item once under a given experimental condition, but all items appeared in all conditions across lists. The 50 filler translation pairs were the same in the seven versions of the experiment.

Procedure and Apparatus

The task used in this experiment was a translation recognition task. In each trial, participants saw a word in Catalan (L2) followed by a word in Spanish (L1) and had to decide whether the second word was the correct translation of the first. The complete sequence was as follows. After pressing a start button, a fixation point (#) appeared on the screen for 750 milliseconds (ms). It was immediately followed by the Catalan word, which was replaced by the Spanish word after 750 ms. The Spanish word also appeared for 750 ms. Both words were presented in uppercase. Reaction time was recorded to the nearest ms from the onset of the presentation of the second word. This procedure was the same as that used by Ferré et al. (2006), except that in the current experiment the time of presentation of the first word was 250 ms longer given the low proficiency level in Catalan of the beginning learners.

Participants were tested in separate soundproof booths. They indicated their decisions by pressing one of two response buttons, using their preferred hand for the 'yes' responses. The order of presentation of the items was randomized for each participant. The display of the stimuli and recording of reaction times and error percentages were controlled by the DMastr package developed by Forster and Forster (1990). A block of 12 practice trials was presented before the experiment.

Results

The data corresponding to incorrect responses were discarded from the analyses. Reaction times (RTs) that were more than two standard deviations above or below the mean for a given participant in all conditions were trimmed to the appropriate cutoff values. This trimming procedure led to a replacement of 4.2% of all trials. Any participant who made an error rate above 15% (proficient and intermediate group of participants) or 20% (beginner group) was removed from the data analyses. These criteria led to the exclusion of 12 participants (6 beginners, 1 intermediate, and 5 proficient bilinguals). The mean RTs and percentage of errors (%E) across the seven different experimental conditions are shown in Table 3.

Translation Data

Translation data were analyzed because they were considered as an independent test of the three levels of proficiency established on the basis of the language

Table 3. Error Rate and Mean Reaction Time (RT) for the Three Groups of Participants

Conditions	Beginning language learners		Intermediate language learners		Proficient bilinguals	
	Error Rate	RT	Error Rate	RT	Error Rate	RT
Translation (*ruc – burro*; 'donkey – donkey')	18.8	829.7	8.0	827.9	5.7	601.2
Very close pairs (*ruc – caballo*; 'donkey – horse')	26.3	970.9	14.0	1004.9	16.9	721.0
Control 1 (*ruc – domingo*; 'donkey – Sunday')	17.5	1049.6	6.7	923.6	3.4	680.8
Close pairs (*ruc – oso*; 'donkey – bear')	11.3	977.8	6.0	930.3	4.6	683.2
Control 2 (*ruc – sed*; 'donkey – thirst')	17.5	969.3	7.3	900.5	2.4	671.5
Form – related pairs (*ruc – berro*; 'donkey – watercress')	21.9	1089.6	6.0	996.3	12.9	747.5
Control 3 (*ruc – lejía*; 'donkey – bleach')	11.9	976.7	0.7	938.6	4.4	670.9

questionnaire. Two analyses of variance (ANOVAs) on the RTs and %E were performed, one for the participants' means and the other for the items' means. In both analyses, a significant effect was revealed for group on RT, $MinF'(2, 194) = 16.50$, $p < .01$, and %E, $MinF'(2, 233) = 5.37$, $p < .01$.

Planned comparisons of the RT data were carried out in order to compare the three groups. The results revealed that proficient bilinguals were significantly faster in responding than both intermediate learners, $t_1(83) = 5.50$, $p < .01$, $t_2(69) = 9.39$, $p < .01$, and beginning learners, $t_1(84) = 5.73$, $p < .01$, $t_2(69) = 9.20$, $p < .01$. The difference between the two groups of learners did not reach significance. Regarding response accuracy, beginners showed a significantly higher percentage of errors (18.8%) than did both intermediate (8%), $t_1(29) = 2.37$, $p < .05$, $t_2(69) = 2.67$, $p < .01$, and proficient bilinguals (5.7%), $t_1(84) = 4.68$, $p < .01$, $t_2(69) = 4.45$, $p < .01$. The difference between the intermediate and proficient participant groups was not significant, $t_1(83) = .98$, $p > .05$, $t_2(69) = 1.32$, $p > .05$. The differences in RT and accuracy for the three groups provide additional support for the validity of the proficiency distinction.

Non-translation Data

We performed an ANOVA on participants means and items means for both RT and %E. Two factors were included in the analysis. The first was group, with three levels (beginning and intermediate language learners and proficient bilinguals), which was a between-subjects factor in the participants analysis and a within-subjects factor in the analysis by items. The second was type of relation, with three levels (very close semantic relation, close semantic relation, and form relation). This last factor was treated as a within-subjects factor in both analyses and was obtained by subtracting data belonging to control conditions from data from the very close, close, and form-related conditions.

The ANOVAs performed on the RTs showed that there was a significant main effect of the type of relation both by participants and by items, $MinF'(2, 254) = 3.83$, $p < .05$. The main effect of group was only significant in the analysis by items, $F_1(2, 98) = 2.26$, $p > .05$, $F_2(2, 138) = 5.88$, $p < .01$. The interaction between the two main effects reached significance in both analyses, $MinF'(4, 463) = 2.51$, $p < .05$.

The ANOVAs of the %E, revealed a significant effect of the type of relation by $MinF'(2, 320) = 7.10$, $p < .01$, although group in this case was only significant in the analysis by participants, $F_1(2, 98) = 3.22$, $p < .05$, $F_2(2, 138) = 1.91$, $p > .05$. Finally, the interaction between the two factors did not reach significance in either analysis, $F_1(4, 196) = 1.09$, $p > .05$, $F_2(4, 276) = .54$, $p > .05$.

Planned comparisons of the RT and %E were carried out between each related condition and its control. An interference effect should have been obtained if

participants were slower to respond, committed more errors, or both in the related conditions (i.e., false translation pairs) than in the non-related ones (i.e., controls). The results are reported separately below for each group of participants.

Beginning language learners. Planned comparisons of the RTs showed that there was not a significant interference effect in the very close semantic condition in the participants analysis, $t_1(15) = -1.81$, $p > .05$. In the item analysis, the effect observed reached significance, $t_2(69) = -2.15$, $p < .05$, but in the opposite direction (i.e., faster responses in the very close condition than in its control condition). No significant interference effect was observed in the close semantic condition, $t_1(15) = .25$, $p > .05$, $t_2(69) = -.11$, $p > .05$, either. However, this group of learners was sensitive to the form manipulation, as they responded significantly slower in the form-related condition (1089.6 ms) than in the control condition (976.7 ms), $t_1(15) = 2.42$, $p < .05$, $t_2(69) = 2.24$, $p < .05$.

A similar pattern of results was found when considering %E. We failed to obtain a significant interference effect in the very close condition in the analysis by participants, $t_1(15) = 2.05$, $p > .05$, although this effect reached significance in the analysis by items, $t_2(69) = 3.24$, $p < .01$. Furthermore, there was not a significant difference in the %E in the close condition when compared to its corresponding control, $t_1(15) = -1.72$, $p > .05$, $t_2(69) = -1.32$, $p > .05$. As in the case of the RTs, a significant interference effect was obtained for the form-related pairs, $t_1(15) = 2.24$, $p < .05$, $t_2(69) = 2.45$, $p < .05$.

Intermediate language learners. The same planned comparisons were performed for the RT and %E for the intermediate language learners. Concerning RTs, there was a significant interference effect in the very close condition (81.3 ms), $t_1(14) = 4.31$, $p < .01$, $t_2(69) = 3.04$, $p < .01$. However, this effect did not reach significance in the close condition, $t_1(14) = 1.38$, $p > .05$, $t_2(69) = 1.18$, $p > .05$. Similar to the effect observed in beginning learners, a significant interference effect (57.7 ms) was obtained in the case of the form related pairs, $t_1(14) = 3.57$, $p < .01$, $t_2(69) = 3.13$, $p < .01$. The magnitude of this form interference effect did not differ significantly from that observed in the beginning learner group, $t_1(29) = 1.09$, $p > .05$, $t_2(69) = .38$, $p > .05$.

When analyzing %E, we observed a clear interference effect in the very close condition, $t_1(14) = 2.32$, $p < .05$, $t_2(69) = 3.03$, $p < .01$, and a non-significant effect in the close condition, $t_1(14) = -.52$, $p > .05$, $t_2(69) = -.82$, $p > .05$. Concerning the form-related pairs, a significant interference effect was obtained in both the participant and the item analyses, $t_1(14) = 2.09$, $p = .056$, $t_2(69) = 2.74$, $p < .01$.

Proficient bilingual group. Planned comparisons on data from the proficient participants group on RT revealed a clear interference effect in the very close condition (40.2 ms), $t_1(69) = 3.96$, $p < .01$, $t_2(69) = 3.56$, $p < .01$. There was not a significant difference in the magnitude of this effect when compared to that observed

in the intermediate participants group (40.2 ms vs. 81.3 ms), $t_1(83) = 1.74$, $p > .05$, $t_2(69) = 1.42$, $p > .05$. Furthermore, proficient bilinguals were clearly slower when responding to form related pairs than to their controls, $t_1(69) = 9.64$, $p < .01$, $t_2(69) = 6.62$, $p < .01$. The magnitude of this form interference effect was not different from that observed in the intermediate learner group, $t_1(83) = -1.01$, $p > .05$, $t_2(69) = -.70$, $p > .05$, or in beginning learner group, $t_1(84) = 1.32$, $p > .05$, $t_2(69) = -.01$, $p > .05$. As with the two learner groups, we failed to obtain a significant interference effect in the close semantic condition, $t_1(69) = 1.82$, $p > .05$, $t_2(69) = .97$, $p > .05$.

Concerning %E, as in the case of the intermediate learners, we observed clear interference effects in the very close condition, $t_1(69) = 8.46$, $p < .01$, $t_2(69) = 5.68$, $p < .01$. However, the proficient bilinguals also showed a significant interference effect in the close condition, $t_1(69) = 2.30$, $p < .05$, $t_2(69) = 2.11$, $p < .05$. One must take into account that this effect was not observed in RTs, therefore, we cannot conclude that there is a clear interference effect with the closely related pairs. Finally, similar to the what we observed with the two learner groups, there was a significant interference effect in the form-related condition, $t_1(69) = 4.73$, $p < .01$, $t_2(69) = 4.83$, $p < .01$.

Discussion

The present study was designed to investigate the role that L2 proficiency can play in determining how connections between lexical and semantic representations are established in the course of acquiring a second language. This question was addressed by comparing performance of three groups of native Spanish speakers with different level of proficiency in their L2 (Catalan) (i.e., beginners, intermediates, and highly proficient bilinguals) in a translation recognition task. The critical conditions consisted of words from each language that were false translation word pairs, either related in meaning (the L1 had a very close or a close non-associative semantic relation to the L2 word) or in form (the L1 word was a translation neighbor of the L2 word). The results revealed differences in the patterns of interference effects in the three groups of participants, in particular, regarding the influence of the semantic manipulation. In line with the results reported by Ferré et al. (2006), the beginning L2 learners showed interference when the words were related in form but not when the two words were semantically related. Intermediate L2 learners showed form interference effects but, unlike beginners, interference was also observed when the semantic relation was very close. Finally, similar to what was observed with intermediate learners, proficient bilinguals showed interference effects with both form and very closely related words, which is in line with the results of Ferré et al.'s proficient group.

Focusing first on the influence of form relations in the performance of the three groups, the results suggest that form sensitivity does not seem to depend on L2 proficiency since the magnitude of the interference effect was not significantly different across the groups. This finding contrasts with findings reported by Sunderman and Kroll (2006) with less and more proficient learners. In the form condition similar to the one included in this experiment (i.e., translation neighbor, *cara-fact*), these researchers observed that only the less proficient group showed an interference effect with form related words, while the more proficient group failed to do so. In our case, however, both intermediate and highly proficient bilinguals were sensitive to the same form manipulation.

One possible explanation of this disparity in the pattern of results could be due to differences in the degree of form similarity between the translation neighbors that were selected for the form related condition across the studies. It might be possible that our translation neighbors were more similar than those used in previous studies (and produced therefore a greater interference). However, this does not seem to be the case. Using the same orthographic similarity measure (Van Orden, 1987), we computed the similarity between the translation neighbor pairs available from Sunderman and Kroll's (2006) study and found that the average orthographic similarity of our pairs (0.65, SD = 0.13) was very similar to the one obtained with their word pairs (0.70, SD = 0.08). It would be interesting, nevertheless, to investigate in future studies whether the degree of form similarity between L1 and L2 words influences the size of the interference effects, as has been shown to be the case when the semantic relatedness is manipulated.

Another possibility to be considered is that the overall greater form sensitivity observed in our experiment, in comparison to that obtained in prior studies, might be attributed to the close relationship between Spanish and Catalan if we compare them to Spanish and English, which are the pair of languages used in the other studies (e.g., Sunderman & Kroll, 2006; Talamas et al., 1999). Spanish and Catalan, in contrast to English, are both Romance languages, and there are a great number of words that are similar in form across the two languages. However, it is not clear how this closer similarity in form between the languages could account for our different pattern of results. The form relation in these translation recognition experiments was a manipulation within the language and not across languages. That is, the second (Spanish) word in the non-translation pairs in the form related condition was orthographically similar to the correct translation of the first word (in Catalan) (for example, in the pair *ruc* – *berro* 'donkey – watercress', the Spanish word *berro* 'watercress' is similar to the Spanish translation of *ruc* – *burro* 'donkey'). Thus, the close similarity between the two languages used does not seem to be relevant in the form conditions examined in these studies.

In our view, a more plausible explanation of the different pattern of results regarding form relations relates to the specific linguistic situation of the participants tested here. As mentioned earlier, the participants were living in a community where the two languages, Spanish and Catalan, are frequently used. In addition, people in this region often change from one language to the other during the same conversation and in written language (e.g., newspapers where the two languages are present). Thus, it might not be surprising that in such a linguistic context, lexical representations of words from the two languages remain active, explaining why our proficient bilinguals are sensitive to form interference with translation neighbors. In this respect, it is interesting to mention that recent findings by Linck et al. (2007) seem to suggest that not only L2 proficiency but also having the opportunity of being immersed in the L2 context can affect the magnitude and type of form interference observed (for more details, see Linck et al., 2007; Sunderman & Kroll, 2006). Nevertheless, additional research would be needed to determine the precise role of linguistic context regarding this issue.

In contrast to form relations, the pattern of semantic interference we found in the three groups demonstrates that level of proficiency in L2 can modulate meaning sensitivity when word relations are purely semantic in nature. In particular, what these results seem to suggest is that a minimum level of proficiency in L2 is required in order for meaning sensitivity to occur. This supports the view that it is only at an early stage of L2 acquisition that conceptual information cannot be accessed directly from L2. At a later stage, L2 learners (at an intermediate level) seem to be sensitive to meaning and, thus, are able to gain access to the conceptual system directly from words presented in the L2, as is the case with proficient bilinguals.

The pattern of effects with purely semantic relations, however, differs from what has been reported in studies examining English speakers learning Spanish (Sunderman & Kroll, 2006; Talamas et al., 1999). For instance, in a recent study, Sunderman and Kroll (2006) compared post hoc the magnitude of semantic interference for related words that were more or less semantically similar with regard to the translation recognition performance of two learner groups with different level of proficiency. Unlike the present study, both less and more similar word relations produced semantic interference effects, and this was the case regardless of proficiency (see also Talamas et al., 1999 for a similar pattern of results when they examined more proficient learners). The different results we found in the present study with very close and close semantic relations cannot be due to differences in L2 proficiency since semantic interference was observed only with words which were very close related in meaning, which was the case for intermediate L2 learners as well as our highly proficient bilingual participants.

Another possible explanation to account for the differences between the above studies concerns the nature of the semantic relation used. As mentioned earlier, in

our studies, purely (non-associative) semantic relations were tested, while both Talamas et al. and Sunderman and Kroll examined mostly associative relations. One might propose that for meaning sensitivity to emerge in purely semantic relations, not only do learners not only have to achieve a minimum level of L2 proficiency but the two semantically related words also need to be highly similar in meaning. However, a priori, there is not clear explanation why this should only be the case for non-associative semantic relations. Alternatively, it also might be possible that the different pattern of results is due to differences in the degree of similarity of the words selected in the above studies. That is, our close semantically related words may be less similar in meaning than those used in previous studies, which would explain why we did not get interference effects with these word relations. In order to test this possibility, a more detailed study needs to be carried out where the degree of semantic similarity of the two sets of semantically related words can be compared. It should be mentioned that our semantically related words were selected on the basis of both similarity ratings and a feature generation task (Sánchez-Casas et al., 2006) and were included as an experimental manipulation (see also Ferré et al., 2006). However, both Talamas et al. (1999) and Sunderman and Kroll (2006) performed a post hoc comparison between more and less similar words, based only on similarity ratings. Thus, the same procedures should be employed across studies to estimate meaning similarity before definitive conclusions can be drawn regarding the influence of meaning similarity in translation performance.

Finally, it is important to provide an explanation of why L2 proficiency can modulate meaning sensitivity when purely semantic relations are used but not when associative relations are used. Although the RHM does not take this factor into account, one might predict different pattern of results for associative and purely semantic relations within the framework of this model. Associative relations reflect lexical-level usage and one can think of them as being the result of one-to-one links established at the lexical level. Thus, processing associative relations across languages would be mediated more by lexical connections than by conceptual connections.

On the contrary, coordinate (purely semantic) relations reflect a tightly organized semantic network. They may be seen as the result of a one-to-one link from a lexical form to a semantic/conceptual representation network. Therefore, processing coordinate relations would rely more upon conceptual than on purely lexical connections. If L2 proficiency and type of semantic relation interact, we might expect learners at early stages of L2 acquisition to be sensitive only to relations that are associative in nature, since they rely more on lexical than conceptual connections when accessing meaning from L2, whereas we would expect learners with an intermediate level of proficiency to be influenced by both associative and purely semantic relations. Further research is needed to test these predictions.

The present study has focused on how lexical and semantic connections between L1 and L2 word representations can be influenced by level of proficiency in L2.The results we have obtained suggest that L2 proficiency is an important factor in determining the way in which these connections are established, even when L2 learning is taking place in an immersion context where the two languages are used frequently. These results also have implications for L2 vocabulary learning since they provide evidence that in the process of acquiring L2 words, direct form (lexical) connections with L1 words are formed in the early stages by the L2 learner, but direct access to the word semantic information appears to be achieved later in the learning process after a basic level of proficiency has been reached. From a methodological point of view, the current study also indicates that the translation interference paradigm we have used could be employed with beginning learners to examine other questions related to L2 vocabulary learning, such as the influence of form similarity, cognate status, or type of semantic relation.

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ARTÍCULO IV

Guasch, M., Sánchez-Casas, R., Ferré, P. y García-Albea, J. E.

Effects of the degree of meaning similarity on cross-language semantic priming in highly proficient bilinguals

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Artículo 4

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Objetivos específicos

- Examinar el patrón de los efectos de *priming* semántico en bilingües muy competentes en sus dos lenguas.

- Comprobar si existen asimetrías en la magnitud de los efectos de *priming* semántico y de traducción en función de la dirección del *priming*, siguiendo la propuesta del Modelo Jerárquico Revisado.

- Determinar si se cumple la hipótesis que se deriva del Modelo de Rasgos Distribuidos de que el *priming* de traducción es más robusto que el *priming* semántico, y de que la magnitud del *priming* dependerá del grado de relación semántica.

- Investigar el papel del grado de semejanza en el significado en los efectos de *priming* semántico a través de lenguas.

Predicciones

Teniendo en cuenta el alto nivel de competencia en sus dos lenguas de los bilingües examinados, y la evidencia previa disponible en la literatura, esperaríamos que nuestros bilingües mostraran efectos de *priming* de traducción y semántico, y que estos efectos fueran de la misma magnitud en ambas direcciones, al igual que lo observado por Perea et al. (2008) em-

pleando a bilingües similares a los nuestros, pero con *priming* enmascarado. Por otra parte, también cabría esperar según el MRD que los efectos de *priming* de traducción fueran mayores que los de *priming* semántico.

Respecto al grado de relación semántica a través de lenguas, tomando en consideración tanto la evidencia previa obtenida con reconocimiento de traducciones (ej.: Sunderman y Kroll, 2006; Talamas et al., 1999) como los resultados obtenidos con monolingües, cabría esperar que el rendimiento en los bilingües muy competentes en sus dos lenguas fuera similar al de los monolingües, es decir, se esperaría una modulación del efecto de *priming* en función del grado de semejanza, lo cual sería consistente tanto con el MJR como con el MRD.

Resumen

El último artículo que se presenta en este trabajo, abordó de nuevo el papel del grado de solapamiento semántico entre palabras en el patrón de efectos de *priming* semántico (véase Artículo 1), pero en este caso a través de lenguas.

Como participantes se seleccionó únicamente a bilingües muy competentes de castellano y de catalán, con el fin de comprobar la capacidad de acceder directamente al nivel conceptual desde el nivel léxico de sus dos lenguas. Para ello, los experimentos se llevaron a cabo en las dos direcciones posibles (de L1 a L2 y de L2 a L1). Con el paradigma de *priming* semántico visible como paradigma experimental, y el conjunto de materiales empleado en los experimentos anteriores, se emplearon las tareas de decisión léxica y de decisión semántica. Asimismo, los pares *prime-target* podían ser traducciones, palabras con una relación semántica muy cercana, cercana, o no tener ninguna relación semántica.

Los resultados mostraron claros efectos de *priming* semántico en ambas tareas tanto en la condición de relación muy cercana como en la cercana. Además, los efectos fueron de mayor magnitud en la condición muy cercana que en la cercana. Otro dato a destacar es que no hubo diferencias en los resultados en función de la lengua del *prime* (L1 ó L2) y que el *priming* de traducción fue significativamente mayor al *priming* semántico en todos los casos.

La conclusión principal es que el grado de solapamiento semántico entre palabras a través de lenguas modula los efectos de *priming* también en bilingües, con palabras cuya única relación es semántica, e independientemente de que la lengua del *prime* sea la primera o la segunda. Destaca sobre todo la similitud de este patrón de resultados con el obtenido en monolingües, lo que estaría en consonancia con las predicciones del MJR: los bilingües muy competentes pueden acceder directamente al significado de las palabras desde sus dos lenguas. Asi-

mismo se confirman las predicciones hechas desde el MRD, tanto en cuanto a que el *priming* de traducción debería ser mayor que el semántico, como en cuanto a que el grado de relación semántica debería modular los efectos de *priming* incluso a través de lenguas.

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Effects of the degree of meaning similarity on cross-language semantic priming in highly proficient bilinguals

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This study aimed to determine if access to meaning can be directly achieved from the words in the two languages, examining the influence of the degree of semantic overlap between related words across languages in the pattern of priming effects. Nonassociative semantically related words (members of the same category) were used, avoiding explicitly associative relationships. Using a priming paradigm, highly proficient Catalan–Spanish bilinguals were visually presented with pairs of words that either were translations of each other, had a very close semantic relationship (in terms of shared features), a close semantic relationship, or no semantic relationship at all. Participants performed either a lexical decision task (Experiment 1) or a semantic decision task (Experiment 2). The main results of the study were the same in both language directions (Spanish–Catalan and Catalan–Spanish), showing that the degree of semantic overlap (in terms of shared features) between words in different languages can modulate priming effects, regardless of the language of the prime and the task used. These results demonstrate that there is cross-language activation of shared semantic representations and, thus, that highly proficient bilinguals can have direct access to word meaning from the two languages.

Keywords: Bilingual representation and access; Degree of semantic overlap; Highly proficient bilinguals; Lexical decision and semantic decision; Semantic priming.

In the study of the representation of words in memory, it is widely accepted that there are two levels of representation: one that has to do with the (orthographic/phonological) form of the word (i.e., the lexical level) and another that has to do with the word's meaning (i.e., the semantic/conceptual level). In the case of bilingual memory, this characterisation must take into account both of the speaker's languages and, therefore, the links between the various levels of representation across the two languages. Models of bilingual memory differ in whether they consider that each language has its own independent lexicon (e.g., the revised hierarchical model [RHM]; Kroll & Stewart, 1994), or in whether they propose a single integrated lexicon for the two languages. Two relevant models of the last type are the bilingual interactive activation model, BIA+ (Dijkstra & van Heuven, 2002), and the distributed lexical/conceptual feature model (DRM), proposed by de Groot and colleagues (de Groot, 1992a, 1992b; de Groot & Hoeks, 1995; van Hell & de Groot, 1998a, 1998b). However, all of these models assume a shared semantic/conceptual level of representation for both languages (see Francis, 1999, 2005, for a review). Within the framework of these models, one question that has received increasing attention is whether direct

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links are established between the lexical representation of words and this common semantic/conceptual representation, and therefore whether bilinguals can access meaning directly from the lexical representations of both the first (L1) and the second language (L2). In this study, we attempted to address this question by examining the performance of highly proficient bilinguals of Catalan and Spanish, in a task where they were asked to process semantically related words from their two languages.

The paradigm that has generally been used to investigate issues concerning semantic representation and access is the semantic priming paradigm. Using this paradigm, it has been found that the recognition of a word (target) is faster and more accurate if preceded by a word (prime) that is semantically related than if it is preceded by an unrelated word (see, for reviews, McNamara & Holbrook, 2003; Neely, 1991). For example, in a lexical decision task (i.e., saying whether a sequence of letters is a word or a nonword), participants respond more quickly to the word "donkey" if it is preceded by "horse" than if it is preceded by "thimble". If one assumes spreading of activation as the mechanism underlying priming, the semantic priming effect would be the result of the activation produced by the prime at the semantic/conceptual level (e.g., horse) gradually spreading to the set of nodes representing the target word's semantic/conceptual information (e.g., donkey). When bilinguals are tested, the language of the prime and the target is manipulated, and one can determine whether the semantic facilitation effect is also present across languages. For example, in English-Spanish bilinguals, if the same facilitation effect is found between "*caballo*" ("horse" in Spanish, L2) and "donkey" (L1) as between "horse" and "donkey", this would indicate that the word in the nontarget language activates shared semantic representations and that direct access to meaning can be achieved from both L1 and L2 lexical forms ("*caballo*" and "horse").

Evidence of cross-language semantic priming effects was reported in studies conducted in the 1980s and the 1990s, when these effects were first examined (e.g., Chen & Ng, 1989; de Groot & Nas, 1991; Frenck & Pynte, 1987; Jin, 1990; Keatley, Spinks, & de Gelder, 1994; Kirsner, Smith, Lockhart, King, & Jain, 1984; Schwanenflugel & Rey, 1986; Tzelgov & Eben-Ezra, 1992; Williams, 1994). However, the diversity of the methodology used in these studies inhibits any reliable comparison. This diversity can be attributed to various factors. First, the studies used different types of semantic relationships, without controlling whether the word pairs had an associative or a purely semantic relationship. Second, the studies used different types of bilinguals whose L2 proficiency level and age of acquisition were not always comparable. And third, the studies differed in terms of the priming procedures used. For example, the interval between the presentation of the prime and the target (i.e., the stimulus–onset asynchrony, or SOA) varied from one study to the next, as did the priming direction (i.e., whether the prime was presented in L1 or L2) (see Altarriba & Basnight-Brown, 2007, for a review).

The studies which have been carried out more recently have attempted to control for these factors, providing a more reliable picture of the existence of semantic priming between-languages (e.g., Basnight-Brown & Altarriba, 2007; Dong, Gui, & MacWhinney, 2005; Duyck, 2005; Kiran & Lebel, 2007; Kotz, 2001; Kotz & Elston-Güttler, 2004; Perea, Duñabeitia, & Carreiras, 2008; Schoonbaert, Duyck, Brysbaert, & Hartsuiker, 2009; Silverberg & Samuel, 2004). Regarding the question presented in this study, that is, if access to the word meaning can be directly achieved from the two languages, the findings from these studies are not conclusive. All of them have shown that semantic priming effects can be obtained between languages in proficient bilinguals in at least a lexical decision task, which is the most commonly used task in studies of this sort. However, the results are less consistent when the language of the prime is manipulated. Significant effects are observed in all the studies in which the prime is presented in L1 (e.g., Basnight-Brown & Altarriba, 2007; Dong et al., 2005; Kiran & Lebel, 2007; Perea et al., 2008), but when the prime is presented in L2, some studies have not found any effects (Basnight-Brown & Altarriba, 2007; Duyck, 2005; Kiran & Lebel, 2007), other studies have reported effects of lesser magnitude (Dong et al., 2005; Kiran & Lebel, 2007; Schoonbaert et al., 2009), and only one study has found effects of the same magnitude as when the prime is in L1 (Perea et al., 2008).

One of the factors that could contribute to explain the presence (or absence) of semantic priming effects when the prime appears in L2 concerns the characteristics of the bilinguals who were tested in these studies. Although in all cases the participants were considered to be very

proficient in both languages, they differed in how balanced they were in terms of level of proficiency and exposure to their first and second language. Only when the bilinguals were equally proficient in their L1 and L2, used both languages and were exposed to them on a daily basis from birth (the Basque-Spanish balanced bilinguals in the study of Perea et al., 2008), did semantic priming effects occur in a similar magnitude, regardless of the language of the prime. In contrast, in the studies where the priming effects from L2 to L1 failed to be consistent, the bilinguals under examination were unbalanced (e.g., Basnight-Brown & Altarriba, 2007; Dong et al., 2005; Duyck, 2005; Kiran & Lebel, 2007; Schoonbaert et al., 2009).

The pattern of priming effects found in balanced bilinguals is consistent with the predictions derived from available models of bilingual memory. For instance, the RHM (Kroll & Stewart, 1994) proposes that in early acquisition stages of the L2, there are only strong connections between the L1 lexical form and the shared semantic/conceptual store, meaning that access to this store from L2 is mediated by the L1 lexical form. With increased proficiency, however, the links between the L2 lexical form and the semantic/conceptual store would strengthen, so that access to the word meaning can be directly achieved from the second language. According to the RHM, therefore, balanced bilinguals are expected to show similar semantic priming effects in both language directions.

The prediction for the DRM would be similar to that of the RHM. The DRM represents the semantic/conceptual word level as a set of nodes which correspond to semantic features and which are connected to the corresponding lexical forms in the two languages (de Groot, 1992a, 1992b; van Hell & de Groot, 1998a, 1998b). For an unbalanced bilingual, it has been suggested that semantic representation would be richer for L1 than for L2 (e.g., Duyck & Brysbaert, 2004; Schoonbaert et al., 2009; Tokowicz, Kroll, de Groot, & van Hell, 2002). This implies that an L1 word activates more conceptual nodes than an L2 word. Under the assumption that the magnitude of the semantic priming depends on the number of semantic features shared by the two languages, priming effects should be greater when an L1 word is presented as a prime (for a similar view, see the ''sense model'' proposed by Finkbeiner, Forster, Nicol, & Nakamura, 2004). In the case of a balanced bilingual, however, both L1 and L2 words activate similar number of conceptual nodes and thus no differences in the magnitude of priming effects are expected as a function of the language of the prime. The experiments reported in the present study examined balanced bilinguals of Catalan and Spanish of the same characteristics as Perea et al.'s (2008) participants, in order to provide a further test of these predictions regarding semantic priming effects between languages.

A bilingual level of proficiency is not the only variable that can determine to what extent shared semantic representations are activated across languages. Variables concerning word semantic characteristics have also proved to be relevant. For instance, there is evidence that concrete words are translated faster (e.g., de Groot, 1992a, 1992b; de Groot, Dannenburg, & van Hell, 1994; van Hell & de Groot, 1998a), and show larger semantic priming effects than abstract words (e.g., Schoonbaert et al., 2009). Similarly, participants are found to be faster and more accurate when recognising or translating words that have a unique meaning in the two languages (one-word translations) than words with multiple translations (e.g., Boada, Sánchez-Casas, García-Albea, Gavilán, & Ferré, 2009; Degani & Tokowicz, 2010; Laxén & Lavaur, 2010; Tokowicz & Kroll, 2007). These findings have been explained within the framework of the DRM, assuming that the number of shared semantic/conceptual nodes is the crucial factor in determining cross-language activation at this level of representation.

According to this model, the meaning of concrete words is less language dependent than the meaning of abstract words and, therefore, the overlap between their semantic representations in terms of shared nodes is greater across the two languages. Regarding the effect of the number of translations, the DRM proposes that the maximum semantic overlap will be observed in the case of word translations that have a single meaning in the two languages, the proportion of shared semantic nodes being smaller for those words with more than one translation.

An additional and novel approach to determine if words from the two languages activate shared semantic representations is to manipulate the meaning overlap between the semantically related words. To our knowledge, none of the available studies has manipulated the degree of similarity in meaning between primes and targets in word recognition performance in bilinguals. If

we define semantic similarity in terms of overlapping semantic features, this variable could be relevant to test some of the predictions of the DRM. As in the case of concrete and unique translations, this model would propose that words that are very closely semantically related would share more nodes of their semantic/conceptual representation, than words that are related in meaning to a lesser degree. Under the assumption that semantic priming effects are sensitive to the number of semantic nodes shared by the two languages, the closer the semantic relationship between the words, the greater the size of the priming effects.

Evidence that the degree of semantic similarity is a good predictor of the magnitude of priming effects has been provided in different monolingual studies (McRae & Boisvert, 1998; Sánchez-Casas, Ferré, García-Albea, & Guasch, 2006; Vigliocco, Vinson, Lewis, & Garrett, 2004). Of relevance here is the study carried out by Sánchez-Casas et al. (2006), who investigated the influence of this variable on the magnitude of priming effects using both a lexical decision task and a semantic decision task (i.e., deciding whether a target word is concrete). In their study, a target word (e.g., ''*burro*'', donkey in Spanish) was preceded by a very closely related word (e.g., ''*caballo*'', horse), a closely related word (e.g., ''*oso*'', bear) or an unrelated word. The semantically related word pairs were words belonging to the same category (i.e., coordinates) and lexical association was explicitly avoided by the authors. Confirming previous studies (e.g., Vigliocco et al., 2004), Sánchez-Casas et al. (2006) found priming effects in the lexical decision task in both the ''close condition'' and the ''very close condition'', with effects of greater magnitude in the latter case. They also found a similar pattern of results with the semantic decision task, demonstrating that the effects were not task dependent. Using the same prime–target word pairs as Sánchez-Casas et al., the experiments reported in the present study tested the balanced bilingual speakers of Catalan and Spanish in the two tasks, lexical decision and semantic decision. The aim was to determine to what extent the degree of meaning similarity between nonassociative semantically related words modulates the pattern of priming effects in the two tasks, reflecting cross-language activation of shared semantic representations.

A final contribution of the present study that is important to mention refers to the type of semantic relations used. Most bilingual priming studies have used prime–target pairs that were semantic and associatively related (e.g., Basnight-Brown & Altarriba, 2007; Dong et al., 2005; Kiran & Lebel, 2007; Perea et al., 2008; Schoonbaert et al., 2009; Silverberg & Samuel, 2004). The only two studies where semantic and associative relations have been tested separately are the ones carried out by Kotz and her colleagues (Kotz, 2001; Kotz & Elston-Güttler, 2004). These authors examined semantic priming in L1 and L2 with only-semantically related words (nonassociated) and associatively related words, using a lexical decision task and highly proficient bilinguals, and registering reaction times (RT) and event-related potentials (ERP) data. They found priming effects in the two languages, but in contrast to monolingual studies (e.g., Bueno & Frenck-Mestre, 2008; McRae & Boisvert, 1998; Sánchez-Casas et al., 2006; Vigliocco et al., 2004), there was no priming in RT with words semantically but not associatively related, although it was obtained in the associated pairs. Regarding the ERP data, Kotz (2001) found evidence of these effects in both types of semantic relations, whereas Kotz and Elston-Güttler (2004) only obtained semantic priming with associatively related words. It has to be taken into account that, although participants in both studies were highly proficient, only those tested by Kotz (2001) were early bilinguals. Thus, the ERP results suggest that the age of L2 acquisition might modulate semantic priming in bilinguals. As there is only one bilingual study that has examined semantic word relations that are nonassociative with early bilinguals (Kotz, 2001), and its results are not in the same line as the monolingual RT data, we have decided to provide an additional test of this type of word relations with early bilinguals of Catalan and Spanish that are regularly exposed to both languages to a similar degree.

To conclude, the two main aims of the present study were, on the one hand, to examine the pattern of between language priming effects in highly proficient balanced bilinguals; and, on the other hand, to investigate the role that the degree of meaning similarity has on cross-language semantic priming effects with nonassociative semantic relations. In order to achieve these aims, we conducted two experiments. Experiment 1 involved a lexical decision task in which the prime could be presented in Catalan and the target in Spanish, or the other way around (i.e., prime in Spanish and target in Catalan). In

Experiment 2, the same word pairs were used in a semantic decision task, also in the two language directions—that is, the prime was in Spanish and the target was in Catalan or vice versa. In the two experiments, prime and target word pairs were presented under three priming conditions: translation, very closely semantically related and closely semantically related. According to the DRM, we would expect to find the largest priming effects in the translation condition since the semantic overlap in this case is maximum (all of them were concrete words with the same meaning in the two languages; e.g., *ruc-burro*, "donkey"). We also expected to find priming effects in the two semantically related conditions, although the size of these effects would be greater when the semantic relation is very close (e.g., *ruc-caballo*, "horse") than when it is close (e.g., *ruc-oso*, "bear"). Moreover, if the semantic activation in the case of balanced bilinguals does not depend on the language of the prime, a similar pattern of semantic priming effects should be observed in both language directions.

EXPERIMENTS

Before beginning with the description of the experiments, we consider it is essential that we briefly characterise the bilinguals who participated in this study. To do so, we need to provide an overview of the linguistic situation in Catalonia, in which Tarragona, the site of the experiments, is situated, and where the bilinguals used in this study were born and currently live. In Catalonia, Catalan and Spanish are co-official languages. People who are born in Catalonia—like the bilinguals who participated in this study—are exposed to both languages from an early age. In day-to-day life in Catalonia, it is common to have conversations involving both languages, and both are used in the media (e.g., newspapers, radio, and television). Upon completing their primary and secondary education, young people are proficient in both Catalan and Spanish, and they keep using the two languages at the university level, where classes can be taught in either language. Due to the frequent exposure to both Catalan and Spanish from early childhood, and in particular to the high proficiency level demonstrated by the bilinguals who participated in these experiments, it is difficult to say which language is dominant. This is not to say, however, that individual speakers do not use one of the languages more than the other. Since this level of exposure to and proficiency in both languages is relevant to the study, we will not refer to the languages as native language (L1) and second language (L2). Instead, we will simply refer to them as Catalan and Spanish (see Perea et al., 2008, for a similar decision in the case of bilinguals of Basque and Spanish).

EXPERIMENT 1

Method

Participants. Seventy-four psychology students from the Rovira i Virgili University (Tarragona, Spain) participated in this experiment as a course requirement. Their average age was 21.9 years ($SD = 5.5$). Forty-two students performed the experiment in the Catalan–Spanish direction, although two of them were eliminated from the study, as their percentage of errors in the experimental task was higher than 15%. The remaining 32 students performed the experiment in the Spanish–Catalan direction.

All the participants were highly proficient bilinguals of Spanish and Catalan who had acquired both languages in their early childhood. Each participant filled out a questionnaire about his or her linguistic background. On a 5-point scale, where 1 was "very bad" and 5 was "very good", participants rated their proficiency in Spanish as 4.8, on average ($SD = 0.4$), and as 4.7 in Catalan ($SD = 0.5$). These ratings clearly indicated that they were very balanced bilinguals. Furthermore, since reading was the skill involved in the experimental task, participants were also asked to estimate how often they read in each language on a 5-point scale (1 = "reading only in Catalan", 5 = "reading only in Spanish"). Their average rating was 3.3 ($SD = 1$), thus suggesting that they read equally often in both languages.

Materials and design. We used the same set of experimental items as Sánchez-Casas et al. (2006) in their study of monolingual priming. It consisted of 72 word triplets. In the Catalan–Spanish direction, each triplet was made up of one Spanish target word and two Catalan words presented as primes (one with a very close semantic relationship to the prime, and the other one with a close semantic relationship; see Appendix A). In the Spanish–Catalan direction,

the 72 word triplets were the same except that the primes were translated into Spanish, and the targets were translated into Catalan (see Appendix B). Additionally, some of the nonwords were modified to follow the rules of orthography and phonology in Catalan, which are different from those of Spanish. Other nonwords were modified to make their structure more similar to that of Catalan words.

For the details of the procedure for establishing the degree of similarity between the semantically related words, see Sánchez-Casas et al. (2006). To briefly recap, the authors used two indices of semantic similarity: (1) the number of features shared by the prime and target words, converted into a numerical value representing the semantic distance between the two words; and (2) estimations of the semantic similarity of the same word pairs obtained using a judgement task involving a 9-point scale. Only purely semantically related word pairs were used; associative pairs were explicitly excluded.

Each target word appeared in one of the following four experimental conditions, each containing 18 items: (a) a translation condition, in which the prime was the correct translation of the target (e.g., in the Catalan–Spanish direction: *ruc-BURRO*, donkey-DONKEY); (b) a very close semantic condition, in which the prime was very closely related to the target (e.g., *cavall-BURRO*, horse-DONKEY); (c) a close semantic condition, in which the prime was less closely related to the target (e.g., *ós-BURRO*, bear-DONKEY); and (d) an unrelated control condition, in which the prime and the target had no semantic relationship and did not even belong to the same semantic category (e.g., *didal-BURRO*, thimble-DONKEY).

In addition to the critical items, we included 72 pairs of primes and targets as fillers, in order to reduce the percentage of related items (i.e., 19%) and therefore prevent strategic factors from coming into play. In order to make the number of "no" answers equal to the number of "yes" answers (i.e., the 144 target words), we also included 144 nonwords, which were presented as targets and always preceded by primes that were words. The nonwords were phonologically and orthographically legal in the language that were simulating.

We developed four different versions of the experiment for each language direction. Taking into account all four versions, each target appeared in each of the four priming conditions, but each participant saw each target just once. The nonwords and filler items were the same in all four versions of the experiment. The primes always appeared in lower case and the targets in upper case. We also developed a practice set of 12 items, which was the same for all versions of the experiment. It included examples of each priming condition, in the same proportion as in the set of experimental items.

Procedure and apparatus. A lexical decision task was used in the experiment. Participants were shown a total of 288 prime–target pairs on a computer-controlled video display. The sequence of the experiment was as follows: After pressing a pedal connected to the computer, an attention point ("+") appeared in the centre of the screen for 250 ms. The prime appeared in the centre of the screen immediately afterwards and remained there for 250 ms. The upper-case target then appeared in the centre of the screen and remained there for 1000 ms. The participants then had to say whether the target was a word or nonword by pressing one of two buttons, marked "yes" and "no" (with the "yes" button always being held by the dominant hand). The items were presented in random order for each participant. After each response, the participants received feedback about their reaction time and response accuracy. The participants carried out the task in individual soundproofed booths. The items were presented and the data were collected by DMDX, a program developed by Forster and Forster (2003). The experiment took about 20 minutes to complete.

Results and discussion

Incorrect responses were excluded from the analyses. Reaction times (RTs) that were more than two standard deviations from the mean for a given participant in all conditions, as well as RTs smaller than 200 ms or greater than 2000 ms, were also discarded (this excluded 3.9% of the data for each language direction). Table 1 shows the mean RT data for correct responses as well as the percentage of errors (%E) for all experimental conditions.

Separate ANOVAs were conducted on the RT data and the%E data. One ANOVA was carried out for the participants' means and another for the items' means. These analyses included the factor "language direction" with two levels (Catalan–Spanish and Spanish–Catalan), manipulated

TABLE 1
Mean RT (in ms) and percentage of errors (%E) in the four experimental conditions and the corresponding priming effects (RT and %E) in the lexical decision task (standard deviations are shown in parentheses)

			Priming effect	
Condition	*Mean*	*%E*	*RT*	*%E*
Catalan–Spanish				
Translation (e.g., *ruc-burro*; "donkey-donkey")	555 (101)	3.0 (3.8)	55**	4.0**
Very close (e.g., *cavall-burro*; "horse-donkey")	576 (94)	4.3 (5.9)	34**	2.7
Close (e.g., *ós-burro*; "bear-donkey")	588 (95)	4.6 (5.6)	22**	2.4*
Control (e.g., *didal-burro*; "thimble-donkey")	610 (101)	7.0 (7.0)		
Spanish–Catalan				
Translation (e.g., *burro-ruc*; "donkey-donkey")	536 (106)	2.5 (4.1)	65**	4.2**
Very close (e.g., *caballo-ruc*; "horse-donkey")	556 (97)	4.9 (4.9)	45**	1.8
Close (e.g., oso-*ruc*; "bear-donkey")	575 (100)	5.5 (6.5)	26**	1.2
Control (e.g., *dedal-ruc*; "thimble-donkey")	601 (96)	6.7 (7.1)		

*$p < .05$, **$p < .01$.

between subjects and between items, and the factor "type of relationship" with four levels (translation, very close, close, and control), manipulated within subjects and within items.

The RT ANOVA showed that the type of relationship had a significant effect when analysed both by participants and by items, $F1(3, 210) = 62.02$, $p < .01$, and $F2(3, 426) = 30.38$, $p < .01$. Conversely, there was not any effect of the language direction, $F1 < 1$, and $F2(1, 142) = 3.52$, $p > .05$. Similarly, the interaction between both factors failed to reach statistical significance (both Fs < 1).

As the language direction did not interact with the type of relationship, we collapsed the data of the two directions (see Figure 1). We carried out planned comparisons between the three related conditions and the control condition. Significant priming effects were found in all the cases: an effect of 59 ms in the translation condition, $t1(71) = 11.66$, $p < .01$, $t2(143) = 9.26$, $p < .01$; an effect of 38 ms in the very close condition, $t1(71) = 8.26$, $p < .01$, $t2(143) = 6.27$, $p < .01$; and an effect of 24 ms in the close condition, $t1(71) = 5.34$, $p < .01$, $t2(143) = 3.52$, $p < .01$. Additionally, we analysed if there were differences among the three conditions in the magnitude of the facilitative effects obtained. As expected, the priming effects were significantly greater in the translation pairs than in either the very closely related pairs (a difference of 20 ms), $t1(71) = 5.20$, $p < .01$, $t2(143) = 3.30$, $p < .01$, or the closely related pairs (35 ms of difference), $t1(71) = 7.89$, $p < .01$, $t2(143) = 5.42$, $p < .01$. There was also a significant difference (14 ms) between the very closely and the closely related words in the amount of priming obtained, $t1(71) = 3.51$, $p < .01$, $t2(143) = 2.42$, $p < .05$.

The %E ANOVA also showed that there were no significant effects of language direction (both

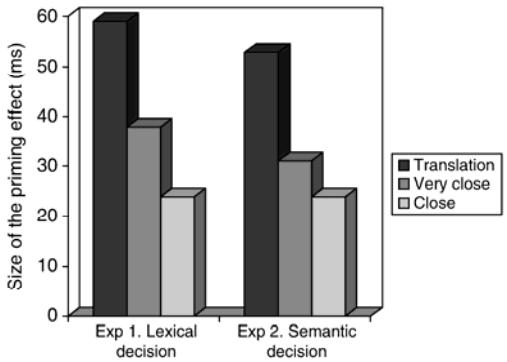

Figure 1. Priming effects (in milliseconds) in Experiment 1 (lexical decision) and Experiment 2 (semantic decision). Data collapsed across language direction.

Fs < 1), and that the type of relationship had a significant main effect when analysed both by participants and by items, $F1(3, 210) = 7.04$, $p < .01$, and $F2(3, 426) = 7.41$, $p < .01$. As in the RT analysis, the interaction between both factors failed to reach statistical significance (both Fs < 1). Therefore, we collapsed the data of the two directions.

Planned comparisons revealed significant priming effects in the%E in the translation condition, $t1(71) = 4.58$, $p < .01$, $t2(143) = 4.04$, $p < .01$, as well as in the very close condition, $t1(71) = 2.12$, $p < .05$, $t2(143) = 2.47$, $p < .05$, and the close condition, $t1(71) = 2.34$, $p < .05$, $t2(143) = 2.04$, $p < .05$. The results also showed that the amount of priming obtained was higher in the translation condition than in either the very close condition (a difference of 1.8), $t1(71) = 2.31$, $p < .05$, $t2(143) = 2.31$, $p < .05$, or the close condition (a 2.2 difference), $t1(71) = 2.71$, $p < .01$, $t2(143) = 2.83$, $p < .01$. However, there was no significant difference between the last two conditions, $t1(71) = 0.45$, $p > .05$, $t2(143) = 0.67$, $p > .05$.

Finally, in order to discard the possibility that the priming effects observed in the related conditions were due to other factors than semantic relatedness, we considered the analyses of the cognate status of the stimuli. This is because cognate words (i.e., words with a similarity in both form and meaning between the two languages) can have an advantage in processing. For instance, if Catalan primes were cognates and had a translation in Spanish very similar in form, it might be that the semantic priming effects obtained were within the language instead of across languages. Among our stimuli, all the targets were noncognates, so there was not any cognate in the translation condition. In the case of the remaining two conditions, we could not avoid the inclusion of cognates between the primes. To test whether the cognate status of the prime had any influence on priming effects, we divided the very close and close pairs on two groups depending on whether the primes in these conditions were cognates or noncognates and we conducted separate analyses. Participants responded significantly faster to the very closely related pairs than to their controls regardless of whether the primes were cognates, $t1(71) = 7.01$, $p < .001$, $t2(107) = 5.78$, $p < .001$, or noncognates, $t1(71) = 3.72$, $p < .001$, $t2(35) = 2.53$, $p < .05$. With respect to the close condition, there were also significant priming effects both with cognate primes, $t1(71) = 5.47$, $p < .001$, $t2(117) = 2.79$, $p < .01$, and with noncognates, $t1(68) = 1.96$, $p = .05$, $t2(25) = 2.57$, $p < .05$.

The results of the present experiment showed that cross-language priming effects could be obtained when the primes had a semantic relationship with the targets. In this way, the present results agree with previous evidence of the existence of semantic priming between languages in bilinguals (e.g., Basnight-Brown & Altarriba, 2007; Dong et al., 2005; Kiran & Lebel, 2007; Schoonbaert et al., 2009). Furthermore, they suggest that when early balanced bilinguals are used, priming effects can be obtained also in the L2–L1 direction, as other authors have reported (e.g., Silverberg & Samuel, 2004). Moreover, there is no effect of the language direction in the magnitude of priming obtained, a finding that is in line with some recent work conducted with the same type of bilinguals (Perea et al., 2008). This pattern of results constitutes support for the RHM model (Kroll & Stewart, 1994) as well as for the DRM model (de Groot, 1992a, 1992b; de Groot & Hoeks, 1995; van Hell & de Groot, 1998a, 1998b), since both of these predict similar priming effects, regardless of language direction, in proficient bilinguals.

A further contribution of this experiment is that it is the first time that bilingual semantic priming has been obtained with behavioural measures (RT) with primes and targets nonassociatively related, as the only previous report of priming effects in L2 with this type of semantic relationships was limited to ERP data (Kotz, 2001). Most importantly, the present results show, for the first time, that priming effects are sensitive to the degree of meaning similarity between primes and targets, as the greatest amount of priming was that obtained in the translation condition, followed by the very close condition and by the close condition. These results constitute a clear support for the DRM.

The next experiment was aimed to test the degree of generalisation of the results of Experiment 1 by using a different task, specifically a semantic decision task, in which participants had to decide whether the target word was concrete. This is a task that some authors consider more suitable to assess semantic processing than lexical decision, as it requires the retrieval and use of semantic information (Bueno & Frenck-Mestre, 2008). Furthermore, in previous monolingual studies, the semantic decision task has been shown to be sensitive to the degree of semantic

similarity between primes and targets (McRae & Boisvert, 1998; Sánchez-Casas et al., 2006).

EXPERIMENT 2

Method

Participants. Seventy-two psychology students from the Rovira i Virgili University, different from those tested in Experiment 1, participated in the present experiment as a course requirement. Their average age was 22.5 years ($SD = 3.9$). Thirty-three students performed the experiment in the Catalan–Spanish direction and 39 students participated in the Spanish–Catalan direction. Four participants were eliminated from the study, since their percentage of errors in the experimental task was higher than 15%.

All the participants were highly proficient bilinguals of Spanish and Catalan who had acquired both languages in their early childhood. They filled out the same questionnaire about their linguistic background as in Experiment 1. Participants rated their language proficiency on a 5-point scale (1 = "very bad", 5 = "very good"). Their average ratings in Spanish and Catalan were 4.7 ($SD = 0.3$) and 4.8 ($SD = 0.3$), respectively. They also rated their frequency of reading as a 3.4 ($SD = 0.6$) on a 5-point scale (1 = "only in Catalan", 5 = "only in Spanish"). According to these ratings, participants were very balanced bilinguals that read equally often in both languages.

Materials and design. The critical stimuli (72 items) and experimental conditions (i.e., translation, very close, close, and control) were the same as those tested in Experiment 1 (see Appendices A and B). The 72 critical prime–target pairs were concrete concrete, so we added 72 unrelated abstract–concrete filler pairs in both language directions (e.g., in the Catalan–Spanish direction: *mesura-AZULEJO*, measure-TILE). Furthermore, in order to make the number of "no" answers equal to the number of "yes" answers (i.e., the 144 target words), we also included 144 filler prime–target pairs in which the target was abstract. Of these pairs, 63 were concrete–abstract (e.g., *llet-ELOGIO*, milk-PRAISE) and 63 were abstract–abstract (e.g., *fluïdesa-VÉRTIGO*, fluency-DIZZINESS), all of which were unrelated. The 18 remaining pairs were abstract–abstract (e.g., *orgull-VANIDAD*, pride-VANITY), but were related. Thus, the proportion of related prime–target pairs was 25%. By keeping this low proportion we ensured that participants would not adopt the strategy of making their semantic decision based on the relationship between words.

As in Experiment 1, we developed four different versions of the experiment for each language direction. Taking into account all four versions, each target appeared in each of the four priming conditions, but each participant saw each target just once. The same filler pairs were used in all four versions of the experiment. Finally, a set of 12 practice items were constructed where all the experimental conditions were represented.

TABLE 2
Mean RT (in ms) and percentage of errors (%E) in the four experimental conditions and the corresponding priming effects (RT and %E) in the semantic decision task (standard deviations are shown in parentheses)

			Priming effect	
Condition	*Mean*	*%E*	*RT*	*%E*
Catalan–Spanish				
Translation (e.g., *ruc-burro*; "donkey-donkey")	655 (97)	3.2 (3.8)	51**	1.6
Very close (e.g., *cavall-burro*; "horse-donkey")	680 (113)	2.2 (3.2)	26*	2.6**
Close (e.g., *ós-burro*; "bear-donkey")	684 (103)	3.7 (4.6)	22*	1.1
Control (e.g., *didal-burro*; "thimble-donkey")	706 (105)	4.8 (5.0)		
Spanish–Catalan				
Translation (e.g., *burro-ruc*; "donkey-donkey")	570 (84)	3.5 (5.2)	56**	1.0
Very close (e.g., *caballo-ruc*; "horse-donkey")	589 (96)	4.5 (6.0)	37**	0.0
Close (e.g., oso-*ruc*; "bear-donkey")	600 (80)	3.8 (4.5)	26**	0.7
Control (e.g., *dedal-ruc*; "thimble-donkey")	626 (81)	4.5 (4.5)		

*$p < .05$, **$p < .01$.

Procedure and apparatus. The procedure was identical to the one used in Experiment 1, except that the decision task was semantic: Participants had to decide whether the word presented in upper case (i.e., the target) was concrete. They did this by pressing one of two buttons, marked "yes" and "no" (with the "yes" button always being held by the dominant hand).

Results and discussion

Incorrect responses were excluded from the analyses. RTs that were more than two standard deviations from the mean for a given participant in all conditions, as well as RTs smaller than 200 ms or greater than 2000 ms, were also discarded (this excluded 4.9% of the data in the Catalan–Spanish direction and 4.1% in the Spanish–Catalan direction). Table 2 shows the mean RT for correct responses and%E data for all experimental conditions.

We conducted two ANOVAs separately on the RT and the%E data, the main factors of which were the same as in Experiment 1. The RT analysis showed that there was a significant effect of both type of relationship, $F1(3, 198) = 24.88$, $p < .01$, and $F2(3, 426) = 29.26$, $p < .01$, and language direction, $F1(1, 66) = 15.23$, $p < .01$, and $F2(1, 142) = 111.11$, $p < .01$, although the interaction between both factors was not significant (both Fs < 1).

Overall, participants in the Spanish–Catalan direction were 85 ms faster than participants in the Catalan–Spanish direction, $t1(66) = 3.86$, $p < .01$, $t2(142) = 10.54$, $p < .01$. However, as the language direction did not interact with the type of relationship, we collapsed the data of the two directions in order to conduct planned comparisons (see also Figure 1). The translation condition was 53 ms faster than the control condition, $t1(67) = 8.37$, $p < .01$, $t2(143) = 8.83$, $p < .01$. In a similar way, participants responded faster to the very closely related pairs (31 ms), $t1(67) = 4.72$, $p < .01$, $t2(143) = 5.98$, $p < .01$, and to the closely related pairs (24 ms), $t1(67) = 4.23$, $p < .01$, $t2(143) = 4.19$, $p < .01$, than to the control stimuli. The comparison between the magnitude of the effects showed that the amount of priming obtained in the translation condition was greater than in either the very close (22 ms), $t1(67) = 3.49$, $p < .01$, $t2(143) = 3.68$, $p < .01$, or the close condition (29 ms), $t1(67) = 4.79$, $p < .01$, $t2(143) = 4.91$, $p < .01$, although there was not any significant difference between the last two conditions in the priming effects obtained, $t1(67) = 1.25$, $p > .05$, $t2(143) = 1.32$, $p > .05$.

Concerning the%E data, the ANOVA failed to show a significant effect of either language direction (both Fs < 1) or type of relationship, $F1(3, 198) = 1.61$, $p > .05$, $F2(3, 426) = 1.94$, $p > .05$. The interaction between both factors was not significant either, $F1(3, 198) = 1.41$, $p > .05$, $F2(3, 426) = 1.14$, $p > .05$.

Finally, as in Experiment 1, we conducted a further analysis by dividing the pairs of the very close and close conditions in cognates and noncognates according to their primes. With respect to the very close condition, the results showed that there were priming effects when the primes were cognates, $t1(67) = 4.28$, $p < .001$, $t2(107) = 4.91$, $p < .001$, as well as when they were noncognates, $t1(67) = 1.95$, $p = .05$, $t2(35) = 3.62$, $p < .01$. In a similar way, participants responded faster to the close related pairs than to their controls when primes were cognates, $t1(67) = 3.93$, $p < .001$, $t2(117) = 4.79$, $p < .001$. However, this was not the case with noncognate primes.

The results of the present experiment were very similar to those of Experiment 1: There was a semantic cross-language priming effect that was not affected by language direction. This effect was obtained with words nonassociatively related and it seemed to partially depend on the degree of meaning similarity between primes and targets, as it was greater with translation equivalents than with words related in meaning. A further contribution of the present experiment is the demonstration that the effects are not task dependent, since we have obtained priming with a task different from that used in Experiment 1. The pattern of results is very similar between the two tasks: In the present experiment, as in the previous one, priming effects were greater with very close pairs than with close pairs. However, a subtle difference from the data of Experiment 1 is that in the semantic decision task, this difference in magnitude did not reach statistical significance.

To our knowledge, no other studies have used the semantic decision task to test semantic priming effects in bilinguals, although it has been used in the monolingual domain (e.g., McRae & Boisvert, 1998; Sánchez-Casas et al., 2006). In this respect, it is interesting to note that in the study of Sánchez-Casas et al. (2006), in which the same set of words and experimental conditions as in the present study were used, the authors reported a very similar pattern of results. That

is, the difference in the size of priming between the very close and the close related pairs did reach statistical significance in the lexical decision task but not in the semantic decision task. Given this similarity across the two studies, it seems reasonable to assume that the factor that determines how the degree of semantic similarity influences priming effects is not whether participants are monolingual or bilingual, but rather the characteristics of the task. Further experiments need to be performed in order to determine to what extent and how the demands and the processes involved in lexical and semantic decision can account for the differences between the two tasks.

GENERAL DISCUSSION

The general aim of the present study was to determine whether bilinguals can directly access the word meaning from the corresponding lexical forms in the two languages. Although previous priming studies have provided evidence that there is cross-language semantic activation, and thus, that a word from one language can activate shared semantic representation within a single conceptual system, the available findings up to now have not been consistent. In particular, these studies have shown reliable priming effects only when the prime is presented in L1, but these effects are not always present nor are they observed to the same degree when prime words are in L2 (Basnight-Brown & Altarriba, 2007; Dong et al., 2005; Duyck, 2005; Kiran & Lebel, 2007; Schoonbaert et al., 2009).

We have suggested that one of the factors that could account in part for this inconsistency was the type of bilinguals tested, since only in the case of balanced bilinguals were priming effects found to be of the same size regardless of the language of the prime (Perea et al., 2008). The results we have reported support this possibility: Highly proficient Catalan–Spanish bilinguals showed reliable semantic priming effects and these effects were of a similar magnitude both when the prime was presented in Catalan and when it appeared in Spanish. This pattern of results is consistent with that observed in Perea et al.'s (2008) study that tested a similar type of bilinguals: early highly proficient bilinguals who had been exposed to both languages on a regular basis since birth. These data suggest that this sort of bilingual speaker is able to directly access shared semantic representations from the lexical forms in either language. Nevertheless, it is important to mention that our bilinguals, as is generally the case, tend to have a dominant language if one considers how frequently they use one or the other language (given the situation in the Basque country this is probably also true for Perea et al.'s bilinguals). Therefore, on the basis of the present findings, we can suggest that dominance characterised in terms of use does not affect the symmetrical nature of the semantic priming effects.

The novel contribution of our study was to examine to what extent the degree of meaning similarity between words that were only-semantically related modulates cross-language priming effects. The results show a similar pattern of semantic priming effects in the two language directions (i.e., Catalan–Spanish and Spanish–Catalan), both in lexical decision and semantic decision tasks. Furthermore, as predicted, priming effects were larger in the translation condition than in the two semantically related conditions (i.e., close and very close). In addition, in line with the results reported in monolinguals (McRae & Boisvert, 1998; Sánchez-Casas et al., 2006; Vigliocco et al., 2004), the degree of semantic similarity seems to modulate the priming effects in the two tasks. That is, semantic priming was obtained with both related and less related word pairs, but the former showed effects of a greater magnitude than the latter.

A final contribution of the present study was to examine priming effects in nonassociative semantically related words. As mentioned in the introduction, very few bilingual studies have distinguished between semantic relationships with and without lexical association (Kotz, 2001; Kotz & Elston-Güttler, 2004). Our findings contrast with those reported in these studies since they failed to find semantic priming effects in RTs using only-semantically related words. In one study, significant priming effects in both L1 and L2 were observed in the ERPs, but not in the RTs (Kotz, 2001), and in the other no evidence of cross-language priming was reported in either of the two measures (Kotz & Elston-Güttler, 2004). At present, we do not have a clear explanation for the disparity in the pattern of results across the different studies. On the one hand, the divergence does not appear to be due to the type of semantic relation, as in the three studies the pairs used as primes and targets were words belonging to the same category (coordinates) without any lexical

association between them. On the other hand, the average degree of semantic relatedness between our primes and targets, as assessed through semantic similarity judgements, was similar to that in the studies of Kotz and her colleagues. A further possibility that could be considered is the bilinguals' characteristics in the different studies. Kotz's (2001) bilinguals were very similar to the bilinguals tested in the present study, but they did not seem to be exposed to both languages on a daily basis to the same degree. However, it is not clear why this difference had to affect the pattern of priming effects depending on either the type of semantic relationship (associative or nonassociative) or the kind of measure (RTs or ERPs) used. Future experiments are required to clarify this issue, examining the influence of both the bilinguals' characteristics and the word relations in the pattern of semantic priming effects using both ERPs and reaction times.

At the beginning of the introduction, we referred to the two bilingual memory models which can provide a framework to account for the priming effects of the sort reported in this study: the RHM and the DRM. The predictions of the two models regarding the pattern of priming effects in the case of highly proficient balanced bilinguals have been supported by the data. According to both models, bilinguals should show priming effects of the same magnitude, regardless of the language of the prime, and this is what the results have clearly demonstrated. With respect to the pattern of priming effects as a function of the degree of semantic similarity between prime–target word pairs, the results have clearly followed the predictions we derived from the DRM. No predictions were made from the RHM, since as it stands, the model does not provide an explanation of how priming effects can be modulated by the semantic overlap between primes and targets. Nevertheless, it should be mentioned that the RHM was originally proposed to account for word translation results in speech production, so it is probably not adequate to use it to explain bilinguals' performance in the visual domain (for a discussion on this issue, see Brysbaert & Duyck, 2010; Kroll, van Hell, Tokowicz, & Green, 2010).

Figure 2 illustrates how the DRM can account for the pattern of semantic priming effects we have obtained in the three word relations (translation, very close semantic relation, and close semantic relation). Two assumptions are essential in this model: that the proportion of shared nodes of the semantic representations of the related words is an index of the semantic overlap between their meanings, and that semantic priming is sensitive to prime–target semantic overlap (characterised in terms of shared semantic features), so the greater the proportion of shared nodes, the greater the size of the priming effects. Given these assumptions, we would expect translations (e.g., *ruc-burro*, donkey) to share the highest proportion of conceptual nodes since the semantic overlap is maximum (see Figure 2).

In the case of semantically related words, the proportion of shared nodes and, thus, the amount of priming would depend on the degree of semantic overlap (shared features) between them. The number of shared features in very close pairs such as *cavall-burro* (horse-donkey) is greater than in the case of *ós-burro* (bear-donkey). Thus, the word *cavall* would activate more common conceptual nodes of the semantic representation of *burro* than the word *ós* (see Figure 2), producing greater semantic priming effects. The results from the two experiments we have reported are clearly consistent with these predictions and fit into an account in terms of the DRM.

To conclude, the present study has provided convincing evidence that balanced bilinguals activate shared semantic representations from

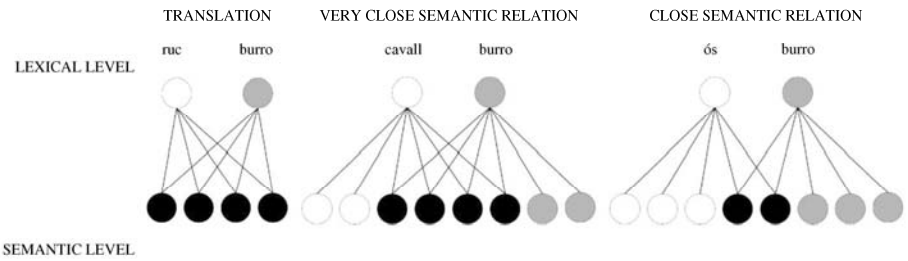

Figure 2. Explanation of the semantic priming effects according to the DRM. The nodes at the semantic level activated by both the prime and the target are represented in black.

the words in their two languages to a similar degree, and that such activation is modulated by how similar in meaning the two words are. More questions need to be answered in order to determine which other factors influence bilinguals' semantic representation and processing. For instance, all the words we used in this study were concrete nouns and translations with the same meaning in the two languages. However, previous evidence obtained with unbalanced bilinguals has shown that concrete words produce more priming than abstract words (Schoonbaert et al., 2009), and that one-single translation words are recognised faster than words with multiple translations (Laxén & Lavaur, 2010; Tokowicz & Kroll, 2007). It would be interesting, therefore, to examine if priming effects with these types of words in balanced bilinguals is similar to that reported with unbalanced bilinguals. In addition, it would also be interesting to further explore how the level of proficiency and language use can modulate the priming effects, using both behavioural and electrophysiological (ERP) measures in order to clarify some of the available findings.

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APPENDIX A
Word targets and primes used in the Catalan–Spanish language direction

Catalan very close	*Catalan close*	*Catalan control*	*Spanish target*
espinacs	carbassa	pal	ACELGAS
(Spinach)	*(Pumpkin)*	*(Stick)*	*(Swiss chard)*
estora	parquet	pingüí	ALFOMBRA
(Mat)	*(Parquet)*	*(Penguin)*	*(Carpet)*
llobarro	foca	camisó	ATÚN
(Sea bass)	*(Seal)*	*(Nightdress)*	*(Tuna)*
canyella	farina	tro	AZÚCAR
(Cinnamon)	*(Flour)*	*(Thunder)*	*(Sugar)*
canoa	avió	faldilla	BARCO
(Canoe)	*(Plane)*	*(Skirt)*	*(Boat)*
terra	gespa	macarrons	BARRO
(Soil)	*(Grass)*	*(Macaroni)*	*(Mud)*
gerra	plat	cangur	BOTELLA
(Jug)	*(Plate)*	*(Kangaroo)*	*(Bottle)*
àliga	estruç	fregidora	BÚHO
(Eagle)	*(Ostrich)*	*(Deep fryer)*	*(Owl)*
cavall	ós	didal	BURRO
(Horse)	*(Bear)*	*(Thimble)*	*(Donkey)*
cogombre	llimona	braç	CALABACÍN
(Cucumber)	*(Lemon)*	*(Arm)*	*(Zucchini)*
mitges	banyador	libèl·lula	CALCETINES
(Tights)	*(Swimsuit)*	*(Dragonfly)*	*(Socks)*
camí	túnel	truita	CALLE
(Path)	*(Tunnel)*	*(Omelette)*	*(Street)*
sofà	taula	pulmó	CAMA
(Sofa)	*(Table)*	*(Lung)*	*(Bed)*
senglar	zebra	tricicle	CERDO
(Wild boar)	*(Zebra)*	*(Tricycle)*	*(Pig)*
encenedor	espelma	bitllet	CERILLA
(Lighter)	*(Candle)*	*(Note)*	*(Match)*
coixí	cortina	llamp	COLCHÓN
(Pillow)	*(Curtain)*	*(Lightning)*	*(Mattress)*
cabra	cérvol	paraigües	CORDERO
(Goat)	*(Deer)*	*(Umbrella)*	*(Lamb)*
cossi	escombra	puça	CUBO
(Tub)	*(Broom)*	*(Flea)*	*(Bucket)*
espasa	pistola	eriçó	CUCHILLO
(Sword)	*(Gun)*	*(Hedgehog)*	*(Knife)*
escalivada	potatge	jersei	ENSALADA
(Grilled vegetables)	*(Vegetable stew)*	*(Sweater)*	*(Salad)*
cirera	pinyó	veler	FRESA
(Cherry)	*(Pine nut)*	*(Sailing boat)*	*(Strawberry)*
pastís	canelons	turmell	GALLETA
(Cake)	*(Canneloni)*	*(Ankle)*	*(Cookie)*
llenties	fideus	samarreta	GARBANZO
(Lentils)	*(Noodles)*	*(T-shirt)*	*(Chickpea)*
oreneta	esquirol	vestit	GORRIÓN
(Swallow)	*(Squirrel)*	*(Dress)*	*(Sparrow)*
mongeta	patata	llanterna	GUISANTE
(Bean)	*(Potato)*	*(Torch)*	*(Pea)*
anguila	abella	saxofon	GUSANO
(Eel)	*(Bee)*	*(Saxophone)*	*(Worm)*
calamarsa	boira	lleó	HIELO
(Hail)	*(Fog)*	*(Lion)*	*(Ice)*
Llana	cadena	arròs	HILO
(Wool)	*(Chain)*	*(Rice)*	*(Thread)*
Llonganissa	truita	davantal	JAMÓN
(Spicy pork sausage)	*(Omelette)*	*(Apron)*	*(Ham)*
Llangardaix	ratolí	estel	LAGARTIJA

APPENDIX A (*Continued*)

Catalan very close	*Catalan close*	*Catalan control*	*Spanish target*
(Lizard)	*(Mouse)*	*(Star)*	*(Small lizard)*
pot	safata	abric	LATA
(Jar)	*(Tray)*	*(Coat)*	*(Tin)*
rentaplats	forn	girafa	LAVADORA
(Dishwasher)	*(Oven)*	*(Giraffe)*	*(Washing machine)*
col	xampinyó	llop	LECHUGA
(Cabbage)	*(Mushroom)*	*(Wolf)*	*(Lettuce)*
neu	tornado	ximpanzé	LLUVIA
(Snow)	*(Tornado)*	*(Chimpanzee)*	*(Rain)*
suro	ciment	fetge	MADERA
(Cork)	*(Cement)*	*(Liver)*	*(Wood)*
taronja	coliflor	orella	MANZANA
(Orange)	*(Cauliflower)*	*(Ear)*	*(Apple)*
arna	titot	telèfon	MARIPOSA
(Moth)	*(Turkey)*	*(Telephone)*	*(Butterfly)*
cloïssa	balena	clauer	MEJILLÓN
(Clam)	*(Whale)*	*(Keyring)*	*(Mussel)*
pruna	nap	sabata	MELOCOTÓN
(Plum)	*(Turnip)*	*(Shoe)*	*(Peach)*
llenguado	gripau	fuet	MERLUZA
(Sole)	*(Toad)*	*(Whip)*	*(Hake)*
goril·la	vaca	test	MONO
(Gorilla)	*(Cow)*	*(Flowerpot)*	*(Monkey)*
ullal	banya	quadern	MUELA
(Fang)	*(Horn)*	*(Notebook)*	*(Tooth)*
titella	puzle	vent	MUÑECA
(Puppet)	*(Puzzle)*	*(Wind)*	*(Doll)*
llimoner	roser	tren	NARANJO
(Lemon tree)	*(Rosebush)*	*(Train)*	*(Orange tree)*
gavina	dofí	violí	PALOMA
(Seagull)	*(Dolphin)*	*(Violin)*	*(Pigeon)*
bufanda	guants	gàbia	PAÑUELO
(Scarf)	*(Gloves)*	*(Cage)*	*(Headscarf)*
oca	tortuga	garatge	PATO
(Goose)	*(Turtle)*	*(Garage)*	*(Duck)*
berruga	gra	cuina	PECA
(Wart)	*(Spot)*	*(Kitchen)*	*(Freckle)*
anell	rellotge	camell	PENDIENTE
(Ring)	*(Watch)*	*(Camel)*	*(Earring)*
farigola	vainilla	llamp	PEREJIL
(Thyme)	*(Vanilla)*	*(Lightning)*	*(Parsley)*
hiena	bou	brusa	PERRO
(Hyena)	*(Ox)*	*(Blouse)*	*(Dog)*
albergínia	nespra	melic	PIMIENTO
(Aubergine)	*(Loquat)*	*(Navel)*	*(Pepper)*
calamar	salmó	llana	PULPO
(Squid)	*(Salmon)*	*(Wool)*	*(Octopus)*
quallada	flam	dit	QUESO
(Curd)	*(Caramel custard)*	*(Finger)*	*(Cheese)*
salamandra	serp	pinzell	RANA
(Salamander)	*(Snake)*	*(Paintbrush)*	*(Frog)*
colze	ull	banc	RODILLA
(Elbow)	*(Eye)*	*(Bank)*	*(Knee)*
cobrellit	tapet	minestra	SÁBANA
(Bedspread)	*(Tablecloth)*	*(Vegetable stew)*	*(Sheet)*
estovalles	manta	peu	SERVILLETA
(Tablecloth)	*(Blanket)*	*(Foot)*	*(Napkin)*
butaca	prestatge	bacallà	SILLA
(Armchair)	*(Shelf)*	*(Cod)*	*(Chair)*
gorra	pantaló	pont	SOMBRERO

APPENDIX A (*Continued*)

Catalan very close	*Catalan close*	*Catalan control*	*Spanish target*
(Cap)	*(Trousers)*	*(Bridge)*	*(Hat)*
teulada	passadís	conill	TECHO
(Roof)	*(Corridor)*	*(Rabbit)*	*(Ceiling)*
vídeo	ràdio	coca	TELEVISIÓN
(Video)	*(Radio)*	*(Flat cake)*	*(Television)*
orca	cranc	jaqueta	TIBURÓN
(Killer whale)	*(Crab)*	*(Jacket)*	*(Shark)*
alicates	tornavís	natilles	TIJERAS
(Pliers)	*(Screwdriver)*	*(Custard)*	*(Scissors)*
huracà	terratrèmol	saler	TORMENTA
(Hurricane)	*(Earthquake)*	*(Saltcellar)*	*(Storm)*
civada	avellana	torradora	TRIGO
(Barley)	*(Hazelnut)*	*(Toaster)*	*(Wheat)*
panses	remolatxa	liquadora	UVA
(Raisins)	*(Beetroot)*	*(Blender)*	*(Grape)*
tassa	plàtera	armilla	VASO
(Cup)	*(Serving dish)*	*(Waistcoat)*	*(Glass)*
porta	armari	iogurt	VENTANA
(Door)	*(Wardrobe)*	*(Yogurt)*	*(Window)*
mula	elefant	tortell	YEGUA
(Mule)	*(Elephant)*	*(Ring-shaped cake)*	*(Mare)*
rave	albercoc	cinturó	ZANAHORIA
(Radish)	*(Apricot)*	*(Belt)*	*(Carrot)*
batut	oli	termòmetre	ZUMO
(Milk shake)	*(Oil)*	*(Thermometer)*	*(Juice)*

APPENDIX B
Word targets and primes used in the Spanish–Catalan language direction

Spanish very close	*Spanish close*	*Spanish control*	*Catalan target*
espinacas	calabaza	palo	BLEDES
(Spinach)	*(Pumpkin)*	*(Stick)*	*(Swiss chard)*
estera	parqué	pingüino	CATIFA
(Mat)	*(Parquet)*	*(Penguin)*	*(Carpet)*
Lubina	foca	camisón	TONYINA
(Sea bass)	*(Seal)*	*(Nightdress)*	*(Tuna)*
canela	harina	trueno	SUCRE
(Cinnamon)	*(Flour)*	*(Thunder)*	*(Sugar)*
canoa	avión	falda	VAIXELL
(Canoe)	*(Plane)*	*(Skirt)*	*(Boat)*
tierra	césped	macarrones	FANG
(Soil)	*(Grass)*	*(Macaroni)*	*(Mud)*
jarra	plato	canguro	AMPOLLA
(Jug)	*(Plate)*	*(Kangaroo)*	*(Bottle)*
águila	avestruz	freidora	MUSSOL
(Eagle)	*(Ostrich)*	*(Deep fryer)*	*(Owl)*
caballo	oso	dedal	RUC
(Horse)	*(Bear)*	*(Thimble)*	*(Donkey)*
pepino	limón	brazo	CARBASSÓ
(Cucumber)	*(Lemon)*	*(Arm)*	*(Zucchini)*
medias	bañador	libélula	MITJONS
(Tights)	*(Swimsuit)*	*(Dragonfly)*	*(Socks)*
camino	túnel	tortilla	CARRER
(Path)	*(Tunnel)*	*(Omelette)*	*(Street)*
sofá	mesa	pulmón	LLIT
(Sofa)	*(Table)*	*(Lung)*	*(Bed)*
jabalí	cebra	triciclo	PORC
(Wild boar)	*(Zebra)*	*(Tricycle)*	*(Pig)*
mechero	vela	billete	LLUMÍ
(Lighter)	*(Candle)*	*(Note)*	*(Match)*
almohada	cortina	rayo	MATALÀS
(Pillow)	*(Curtain)*	*(Lightning)*	*(Mattress)*
cabra	ciervo	paraguas	XAI
(Goat)	*(Deer)*	*(Umbrella)*	*(Lamb)*
barreño	escoba	pulga	GALLEDA
(Tub)	*(Broom)*	*(Flea)*	*(Bucket)*
espada	pistola	erizo	GANIVET
(Sword)	*(Gun)*	*(Hedgehog)*	*(Knife)*
escalivada	potaje	jersey	AMANIDA
(Grilled vegetables)	*(Vegetable stew)*	*(Sweater)*	*(Salad)*
cereza	piñón	velero	MADUIXA
(Cherry)	*(Pine nut)*	*(Sailing boat)*	*(Strawberry)*
pastel	canelones	tobillo	GALETA
(Cake)	*(Canneloni)*	*(Ankle)*	*(Cookie)*
lentejas	fideos	camiseta	CIGRÓ
(Lentils)	*(Noodles)*	*(T-shirt)*	*(Chickpea)*
golondrina	ardilla	vestido	PARDAL
(Swallow)	*(Squirrel)*	*(Dress)*	*(Sparrow)*
judía	patata	linterna	PÈSOL
(Bean)	*(Potato)*	*(Torch)*	*(Pea)*
anguila	abeja	saxofón	CUC
(Eel)	*(Bee)*	*(Saxophone)*	*(Worm)*
granizo	niebla	león	GEL
(Hail)	*(Fog)*	*(Lion)*	*(Ice)*
lana	cadena	arroz	FIL
(Wool)	*(Chain)*	*(Rice)*	*(Thread)*
longaniza	tortilla	delantal	PERNIL
(Spicy pork sausage)	*(Omelette)*	*(Apron)*	*(Ham)*
lagarto	ratón	estrella	SARGANTANA

APPENDIX B (*Continued*)

Spanish very close	*Spanish close*	*Spanish control*	*Catalan target*
(Lizard)	*(Mouse)*	*(Star)*	*(Small lizard)*
bote	bandeja	abrigo	LLAUNA
(Jar)	*(Tray)*	*(Coat)*	*(Tin)*
lavavajillas	horno	jirafa	RENTADORA
(Dishwasher)	*(Oven)*	*(Giraffe)*	*(Washing machine)*
col	champiñón	lobo	ENCIAM
(Cabbage)	*(Mushroom)*	*(Wolf)*	*(Lettuce)*
nieve	tornado	chimpancé	PLUJA
(Snow)	*(Tornado)*	*(Chimpanzee)*	*(Rain)*
corcho	cemento	hígado	FUSTA
(Cork)	*(Cement)*	*(Liver)*	*(Wood)*
naranja	coliflor	oreja	POMA
(Orange)	*(Cauliflower)*	*(Ear)*	*(Apple)*
polilla	pavo	teléfono	PAPALLONA
(Moth)	*(Turkey)*	*(Telephone)*	*(Butterfly)*
almeja	ballena	llavero	MUSCLO
(Clam)	*(Whale)*	*(Keyring)*	*(Mussel)*
ciruela	nabo	zapato	PRÉSSEC
(Plum)	*(Turnip)*	*(Shoe)*	*(Peach)*
lenguado	sapo	látigo	LLUÇ
(Sole)	*(Toad)*	*(Whip)*	*(Hake)*
gorila	vaca	tiesto	MICO
(Gorilla)	*(Cow)*	*(Flowerpot)*	*(Monkey)*
colmillo	cuerno	cuaderno	QUEIXAL
(Fang)	*(Horn)*	*(Notebook)*	*(Tooth)*
títere	puzle	viento	NINA
(Puppet)	*(Puzzle)*	*(Wind)*	*(Doll)*
limonero	rosal	tren	TARONGER
(Lemon tree)	*(Rosebush)*	*(Train)*	*(Orange tree)*
gaviota	delfín	violín	COLOM
(Seagull)	*(Dolphin)*	*(Violin)*	*(Pigeon)*
bufanda	guantes	jaula	MOCADOR
(Scarf)	*(Gloves)*	*(Cage)*	*(Headscarf)*
oca	tortuga	garaje	ÀNEC
(Goose)	*(Turtle)*	*(Garage)*	*(Duck)*
verruga	grano	cocina	PIGA
(Wart)	*(Spot)*	*(Kitchen)*	*(Freckle)*
anillo	reloj	camello	ARRACADA
(Ring)	*(Watch)*	*(Camel)*	*(Earring)*
tomillo	vainilla	rayo	JULIVERT
(Thyme)	*(Vanilla)*	*(Lightning)*	*(Parsley)*
hiena	buey	blusa	GOS
(Hyena)	*(Ox)*	*(Blouse)*	*(Dog)*
berenjena	níspero	ombligo	PEBROT
(Aubergine)	*(Loquat)*	*(Navel)*	*(Pepper)*
calamar	salmón	lana	POP
(Squid)	*(Salmon)*	*(Wool)*	*(Octopus)*
cuajada	flan	dedo	FORMATGE
(Curd)	*(Caramel custard)*	*(Finger)*	*(Cheese)*
salamandra	serpiente	pincel	GRANOTA
(Salamander)	*(Snake)*	*(Paintbrush)*	*(Frog)*
codo	ojo	banco	GENOLL
(Elbow)	*(Eye)*	*(Bank)*	*(Knee)*
colcha	tapete	menestra	LLENÇOL
(Bedspread)	*(Tablecloth)*	*(Vegetable stew)*	*(Sheet)*
mantel	manta	pie	TOVALLÓ
(Tablecloth)	*(Blanket)*	*(Foot)*	*(Napkin)*
butaca	estante	bacalao	CADIRA
(Armchair)	*(Shelf)*	*(Cod)*	*(Chair)*
gorra	pantalón	puente	BARRET

APPENDIX B (*Continued*)

Spanish very close	*Spanish close*	*Spanish control*	*Catalan target*
(Cap)	*(Trousers)*	*(Bridge)*	*(Hat)*
tejado	pasillo	conejo	SOSTRE
(Roof)	*(Corridor)*	*(Rabbit)*	*(Ceiling)*
video	radio	torta	TELEVISIÓ
(Video)	*(Radio)*	*(Flat cake)*	*(Television)*
orca	cangrejo	chaqueta	TAURÓ
(Killer whale)	*(Crab)*	*(Jacket)*	*(Shark)*
alicates	destornillador	natillas	ESTISORES
(Pliers)	*(Screwdriver)*	*(Custard)*	*(Scissors)*
huracán	terremoto	salero	TEMPESTA
(Hurricane)	*(Earthquake)*	*(Saltcellar)*	*(Storm)*
cebada	avellana	tostadora	BLAT
(Barley)	*(Hazelnut)*	*(Toaster)*	*(Wheat)*
pasas	remolacha	licuadora	RAÏM
(Raisins)	*(Beetroot)*	*(Blender)*	*(Grape)*
taza	fuente	chaleco	GOT
(Cup)	*(Serving dish)*	*(Waistcoat)*	*(Glass)*
puerta	armario	yogur	FINESTRA
(Door)	*(Wardrobe)*	*(Yogurt)*	*(Window)*
mula	elefante	roscón	EUGA
(Mule)	*(Elephant)*	*(Ring-shaped cake)*	*(Mare)*
rábano	albaricoque	cinturón	PASTANAGA
(Radish)	*(Apricot)*	*(Belt)*	*(Carrot)*
batido	aceite	termómetro	SUC
(Milk shake)	*(Oil)*	*(Thermometer)*	*(Juice)*

III.- DISCUSIÓN GENERAL Y CONCLUSIONES

3.1.- Discusión general

En el capítulo anterior hemos visto cómo se llevó a cabo el trabajo experimental de esta tesis. Los artículos presentados comprenden un total de seis experimentos cuyos resultados nos van a servir para abordar los objetivos que inicialmente nos hemos planteado. Recordemos que el objetivo general de esta tesis era el de estudiar el proceso de adquisición de las palabras de la L2 basándonos en el reconocimiento visual de palabras. Este objetivo se operativizó desglosándolo en otros objetivos concretos, que se detallan en el capítulo introductorio y que serán recuperados en esta discusión en el mismo orden en el que se han presentado en la introducción.

3.1.1.- El problema del acceso al nivel semántico/conceptual desde la segunda lengua: la ruta léxica vs. la ruta conceptual

El primero de los objetivos era el de examinar la propuesta evolutiva del MJR de que el nivel de competencia del bilingüe en su segunda lengua determinaría si es posible acceder al nivel semántico/conceptual directamente desde la L2, o si sería necesario un acceso mediado por la L1. En otras palabras, al traducir de la L2 a la L1, los aprendices de una segunda lengua harían un uso preferente de la ruta léxica (que pasaría por la L1), mientras que con un alto nivel de competencia los bilingües harían un mayor uso de la ruta conceptual (un acceso directo desde la L2). Desde el MRD no hablaríamos de dos rutas distintas, sino de que las representaciones conceptuales de las palabras de la L2 serían más pobres que las de la L1 en el caso de los aprendices, pero no habría diferencias en el caso de los bilingües más competentes. Además, queríamos añadir el estudio del papel de la edad de adquisición de la segunda lengua, con el fin de ver si esta variable interactuaba de algún modo con el nivel de competencia.

Los experimentos que abordan estas cuestiones son los dos presentados en Ferré, Sánchez-Casas y Guasch (2006; Artículo 2) y Guasch, Sánchez-Casas, Ferré y García-Albea (2008; Artículo 3). Si tomamos los resultados de los dos experimentos en conjunto, podemos hacer las siguientes observaciones. En relación a la interferencia provocada por el parecido formal de las palabras, podemos comprobar que todos los grupos de participantes mostraron claros efectos de interferencia sin diferencias significativas de magnitud entre grupos, es decir, con independencia de su nivel de competencia, y este hecho se observó en ambos experimentos. Estos datos sugieren que la sensibilidad respecto a la forma de las palabras no depende del nivel de competencia, y por lo tanto, que aunque los bilingües competentes tengan muy desarrolladas sus conexiones directas con el nivel conceptual, las conexiones entre lenguas en el nivel léxico no desaparecerían. Hasta aquí los resultados coinciden con las predicciones del MJR, ya que este modelo predice el fortalecimiento de las conexiones conceptuales de los aprendices a medida que aumenta su nivel de competencia, pero no un debilitamiento de las conexiones léxicas una vez el bilingüe se vuelve muy competente en su segunda lengua. Aunque estos resultados coinciden globalmente con lo observado por Talamas et al. (1999), no coinciden con los resultados de los bilingües competentes del estudio de Sunderman y Kroll (2006), ya que en este estudio no se observó la interferencia formal observada por nosotros con los grupos de bilingües más competentes. La explicación más plausible para esta discrepancia sería atribuir las diferencias al contexto en el que se llevaron a cabo los experimentos. El trabajo expuesto aquí se realizó íntegramente en Cataluña con bilingües de castellano y catalán. En esta región ambos idiomas se emplean indistintamente en la vida diaria y sería muy difícil pasar una semana viviendo en Cataluña sin oír alguna de las dos lenguas. Por lo tanto, es factible pensar que ambos léxicos se encuentran normalmente activos. En cambio, el trabajo de Sunderman y Kroll (2006) fue realizado con bilingües de inglés y español en un contexto donde la exposición al español quedaba circunscrita al aula. En conclusión, quizá la mayor exposición a la segunda lengua explicaría estas discrepancias, aunque cabe destacar que ambos resultados son, *a priori*, consistentes con las predicciones del MJR.

Si nos centramos ahora en las relaciones semánticas observamos claras diferencias entre las cercanas y las muy cercanas. Podríamos decir que globalmente ningún grupo de participantes mostró una interferencia clara ante las relaciones cercanas, así que por ahora nos centraremos únicamente en las relaciones muy cercanas, dejando las relaciones cercanas para un apartado posterior, cuando tratemos el tema del grado de relación semántica entre palabras. En las relaciones semánticas muy cercanas, tanto el grupo de bilingües tempranos empleado en Ferré et al. (2006) como el grupo de bilingües competentes de Guasch et al. (2008), obtuvieron rendimientos similares: ambos mostraron claros efectos de interferencia, lo cual indica

que este tipo de bilingües son capaces de acceder directamente al nivel conceptual desde las dos lenguas. Este hecho es, de nuevo, consistente con lo esperado según el MJR y coincide con lo observado en la literatura previa con este tipo de bilingües (Altarriba y Mathis, 1997; Ferré et al., 2001; Sunderman y Kroll, 2006; Talamas et al., 1999). Sin embargo, de forma crítica para el MJR esperaríamos que la magnitud de la interferencia semántica fuera mayor que la formal en los bilingües competentes, y en cambio esto no fue así. En el experimento presentado en Ferré et al. (2006) la magnitud de la interferencia semántica únicamente fue mayor que la formal en los datos relativos a los porcentajes de errores, y en el experimento presentado en Guasch et al. (2008) no se dio esta diferencia ni en los tiempos de reacción, ni en los porcentajes de errores. Estos datos no confirman las predicciones del MJR, y la explicación de por qué sucede esto no está clara, aunque no son los únicos datos en la literatura que van en este sentido. Recientemente, Moldovan, Sánchez-Casas, Demestre y Ferré (en prensa), empleando también la tarea de reconocimiento de traducciones, a bilingües muy competentes de castellano y catalán, y los mismos materiales que en los trabajos presentados aquí, obtuvieron mayor interferencia de significado que de forma únicamente en los porcentajes de errores. Cabe decir que el castellano y el catalán son ambas lenguas romances que comparten gran número de formas léxicas y tienen en sus léxicos multitud de palabras cognadas (i. e.: palabras parecidas tanto en la forma como en el significado a las de otra lengua). Este hecho, unido a lo dicho anteriormente sobre que el contexto particular de Cataluña podría favorecer la activación simultánea de ambas lenguas, explicaría quizá la gran magnitud de la interferencia formal observada. De esta manera, sería el aumento en la interferencia formal al acortar sus distancias con la magnitud de la interferencia semántica, la responsable de no observar la diferencia esperada entre la interferencia de forma y la de significado.

Por su parte, los dos grupos de aprendices de la segunda lengua no mostraron efectos significativos de interferencia semántica en los tiempos de reacción, aunque sí mostraron cierta interferencia en los porcentajes de errores cometidos. En Ferré et al. (2006) se observó interferencia semántica de las relaciones muy cercanas en los errores en los análisis por sujetos y en los análisis por ítems, aunque este efecto fue de menor magnitud que el hallado en los bilingües competentes. En cambio, en Guasch et al. (2008), en los aprendices solamente se halló efecto de interferencia en las relaciones semánticas muy cercanas en el análisis de los errores por ítems. Globalmente todo ello parece sugerir que incluso las personas que están en las etapas iniciales de aprendizaje de una segunda lengua pueden acceder, aunque de forma limitada, al nivel conceptual desde las palabras de su segunda lengua, lo cual es consistente con los datos observados en algunos de los estudios comentados en la introducción que muestran también que los aprendices son sensibles a manipulaciones semánticas utilizando tareas simi-

lares (ej., Altarriba y Mathis, 1997; Comesaña et al., 2009; de Groot y Poot, 1997; Dufour y Kroll, 1995; Ferré et al., 2001; Frenck-Mestre y Prince, 1997; Sunderman y Kroll, 2006; Talamas et al., 1999). Por una parte, el hecho de que los efectos de interferencia formal hayan sido claros en los grupos de aprendices, y que la interferencia semántica haya sido menor (ya que en caso de observarse, solamente ha aparecido en los errores) confirma la predicción del MJR de que los bilingües menos competentes se basan en sus conexiones léxicas con la L1 en mayor medida que en las conexiones conceptuales a la hora de traducir de la L2 a la L1. Por otra parte, el hecho de que bilingües con tan poco nivel de competencia mostraran indicios de un acceso directo al nivel conceptual desde la L2 también es compatible con el modelo (puesto que lo que se predice es una asimetría entre interferencia formal y semántica, y no una falta absoluta de interferencia semántica). Además, todo esto es coherente con el contexto en el que se han llevado a cabo los experimentos: en un contexto de inmersión intensiva como el que se vive en Cataluña es posible que la alta exposición de los aprendices a la segunda lengua ayude a crear desde etapas muy iniciales las conexiones directas entre el léxico y los conceptos (Kroll, Michael y Sankaranarayanan, 1998). Anteriormente ya hemos comentado que el contexto puede ser importante a la hora de buscar una posible causa por la que los bilingües muy competentes podrían mostrar interferencia formal y por qué en estos bilingües la interferencia formal podría ser de la misma magnitud que la semántica. Así, poco a poco va quedando claro que una futura línea de investigación en este ámbito debería explorar con detalle la importancia del tipo de contexto en el proceso de adquisición de la segunda lengua, cuyo interés se demuestra por el reciente aumento en el número de publicaciones que tratan este tema (ej.: Collentine, 2004; Collentine y Freed, 2004; Dewey, 2004; Freed, Segalowitz y Dewey, 2004; Lafford, 2006; Linck, 2005; Segalowitz y Freed, 2004).

Centrémonos ahora en el grupo de bilingües intermedios de Guasch et al. (2008). Este grupo fue incluido para establecer una gradación más precisa en los niveles de competencia de los bilingües, frente a la tradicional división bipolar entre aprendices y competentes (ej.: Sunderman y Kroll, 2006; Talamas et al., 1999). Los resultados con el grupo de bilingües intermedios, situados entre los otros dos grupos, nos darán una idea acerca de si los cambios debidos al nivel de competencia se producen de forma más inicial o más tardía en el proceso de aprendizaje, en función de si el rendimiento de los intermedios es más parecido al de los aprendices o al de los bilingües más competentes. Como se puede comprobar, los resultados con los bilingües intermedios siguieron exactamente el mismo patrón que el de los bilingües más competentes (i e.: unos claros efectos de interferencia tanto formal como semántica en las relaciones muy cercanas, de la misma magnitud que los obtenidos por los bilingües competentes), lo que nos lleva a concluir que es necesario adquirir cierto nivel de competencia para

mostrar una mediación conceptual consistente desde la L2 (ya que esto no se observa en los menos competentes), pero que en niveles intermedios ya es posible acceder directamente a la información conceptual desde las palabras de la segunda lengua.

Finalmente, nos quedan por analizar los resultados obtenidos en los bilingües competentes pero con una edad de adquisición tardía de la L2, estudiados en el trabajo de Ferré et al. (2006). El rendimiento de estos bilingües en contraposición con el rendimiento de los aprendices y de los competentes, fue mucho más similar al de estos últimos que al de los primeros, aunque no fue exactamente igual. Los participantes tardíos mostraron una clara interferencia semántica solamente en los errores, aunque esta interferencia fue igual en magnitud a la de los competentes tempranos y mayor en magnitud a la interferencia causada por la forma de las palabras. Lo que esto nos indica es que tiene más peso el nivel de competencia que la edad de adquisición, ya que en caso contrario el rendimiento debería haber sido más parecido al de los aprendices (de edad de adquisición tardía, por definición). No obstante, el hecho de que los resultados no sean iguales al cien por cien comparados con los de los bilingües competentes por el hecho de que la interferencia semántica se observó de forma clara únicamente en los porcentajes de errores, indica que la edad de adquisición, aunque no es el factor más relevante, tiene también su peso en el proceso de adquisición de la segunda lengua. Así pues, respecto a la edad de adquisición, si bien no se trata de una variable que haya sido contemplada por el MJR ni por el MRD y no pueden hacerse predicciones desde estos modelos, nuestros datos sugieren que debería ser tenida en cuenta. De hecho, si recordamos la introducción, varios trabajos habían estudiado previamente esta variable, aunque en ellos se había empleado el paradigma de *priming* semántico en lugar de la tarea de reconocimiento de traducciones (Kotz, 2001; Kotz y Elston-Güttler, 2004; Silverberg y Samuel, 2004). En los trabajos de Kotz, como en nuestro caso, se destacó la importancia de ambas variables ya que en los tiempos de reacción el patrón de efectos de *priming* con bilingües tardíos fue el mismo que el de los tempranos, mientras que con potenciales evocados los bilingües tardíos se comportaron como los bilingües menos competentes. En cambio, en el trabajo de Silverberg y Samuel (2004) la edad de adquisición era la responsable de marcar las diferencias entre grupos, ya que únicamente los bilingües tempranos mostraron efectos de *priming* semántico significativos. Sin embargo, en este último trabajo los propios autores indican que mientras que sus bilingües tempranos aprendieron su segunda lengua (i. e.: inglés) en un contexto de inmersión (viviendo en los Estados Unidos), sus bilingües tardíos la aprendieron antes de mudarse a los Estados Unidos, en un contexto de instrucción formal. De manera que de nuevo nos encontramos con que el contexto de adquisición podría influir en el proceso de adquisición de la segunda lengua (sin embargo, véase Kotz y Elston-Güttler, 2004), en el sentido de que la in-

mersión lingüística facilitara la conexión directa de las palabras de la L2 con el nivel conceptual (Kroll et al., 1998).

En el siguiente apartado seguiremos con la discusión de los datos obtenidos en nuestros experimentos, centrándonos ahora en el tema del acceso diferencial al nivel conceptual en función de la lengua de acceso, estudiado con los experimentos que han utilizado el *priming* semántico como paradigma experimental.

3.1.2.- El problema de la asimetría en el acceso conceptual: efectos de priming y dirección de acceso

El segundo objetivo de esta tesis era el de estudiar el acceso al nivel semántico desde las dos lenguas del bilingüe, haciendo uso del paradigma de *priming* (semántico y de traducción). Según el MJR, en los aprendices de una segunda lengua el acceso desde la L1 al nivel conceptual sería directo y por lo tanto deberían observarse efectos de *priming* semántico/ de traducción en la dirección L1-L2, mientras que el acceso desde la L2 estaría mediado por la L1 haciendo uso de las conexiones léxicas con esta lengua y por lo tanto no deberían observarse efectos de *priming* semántico/de traducción en la dirección L2-L1, o éstos deberían ser de una magnitud menor que de L1 a L2. En cambio en bilingües competentes, dada su capacidad de acceder directamente al nivel conceptual desde sus dos lenguas, en ambos casos deberían observarse efectos de *priming* semántico/de traducción y de la misma magnitud. Desde el MRD también se podría explicar la asimetría esperada en los bilingües no equilibrados asumiendo que desde la L2 se activaría un menor número de nodos conceptuales que los que activaría la misma palabra en la L1.

El paradigma de *priming* semántico requiere el uso de pares de palabras relacionadas semánticamente. El trabajo presentado en Sánchez-Casas, Ferré, García-Albea y Guasch (2006; Artículo 1) se centró en la obtención de estos pares de palabras, que serían los materiales en castellano que se emplearon en todo el trabajo experimental de esta tesis. Básicamente consistían en tripletes de palabras donde una palabra era un *prime* muy relacionado semánticamente con el *target* (ej.: caballo), otra palabra era un *prime* relacionado en menor medida con el *target* (ej.: oso) y la tercera palabra era el propio *target* (ej.: burro). Lo más importante de todo esto es que estos materiales se eligieron con la idea de examinar los efectos de *priming* con relaciones semánticas puras, en contraposición a las relaciones asociativas. Dos palabras tienen una relación de asociación léxica si la relación entre ambas está basada en su coocurrencia en el uso del lenguaje habitual (ej., tela – araña), mientras que una relación

semántica es aquella en que dos palabras comparten cierta semejanza en su significado o, si asumimos una representación distribuida del nivel semántico, aquella en que dos palabras comparten uno o más nodos semánticos (ej., ballena – delfín). A menudo las palabras coocurren precisamente porque pertenecen al mismo dominio semántico, de manera que en un mismo par de palabras coincide la relación semántica con la relación asociativa (ej., perro – gato). Así, ambos tipos de relaciones están lejos de ser excluyentes y la dificultad en separarlos es una de las causas principales de que habitualmente en la literatura no se haya hecho mucho énfasis en su distinción. Hacer esta distinción es importante por sus implicaciones a nivel teórico, ya que se ha propuesto que las relaciones de tipo asociativo podrían ser el resultado del establecimiento de conexiones de las representaciones de la forma de las palabras en el nivel léxico. En cambio, las relaciones que se basan exclusivamente en el significado estarían representadas dentro de una red semántica integrada (Thompson-Schill, Kurtz y Gabrieli, 1998). Por lo tanto, puesto que la idea era la de emplear estos materiales para estudiar el uso de los bilingües de las rutas léxica y conceptual, no nos interesaba que los materiales mismos sesgaran hacia el uso de una u otra ruta, de modo que se utilizaron únicamente palabras que no tuvieran relación de asociación léxica entre ellas.

En el estudio que nos ocupa de Sánchez-Casas et al. (2006) se incluyó una condición de repetición (la misma palabra repetida como *prime* y como *target*; ej.: burro - burro), una condición de relación semántica muy cercana entre *prime* y *target* (ej.: caballo - burro), otra menos cercana (ej.: oso - burro) y una condición de control (donde el *prime* y el *target* no están relacionados; ej.: dedal - burro). Se utilizó tanto una tarea de decisión léxica como una de categorización semántica. El motivo de la elección de la tarea de decisión léxica fue que es la más empleada habitualmente en este tipo de estudios, de manera que utilizar esta tarea aseguraba la comparación de nuestros resultados con la literatura previa y además es una tarea que garantiza el acceso al léxico y al significado. Y la elección de la tarea de categorización semántica se justifica por ser una tarea que para ser llevada a cabo requiere que el participante procese con mayor detalle el significado de la palabra a la que debe responder, de manera que pensamos que podría reflejar mejor el acceso al nivel conceptual. Por lo que ahora nos interesa, que es la posibilidad de observar efectos de *priming* semántico puro con unos materiales de las características comentadas, los resultados en ambas tareas mostraron claros efectos de *priming* de repetición y de *priming* semántico en ambas condiciones de relación semántica (muy cercana y cercana), lo que demostró que los materiales confeccionados eran adecuados para el estudio de las relaciones semánticas puras (véase McRae y Boisvert, 1998 y Vigliocco et al., 2004).

Pasando ahora a los resultados con bilingües, en el artículo de Guasch, Sánchez-Casas, Ferré y García-Albea (2011; Artículo 4) se replicó el estudio de Sánchez-Casas et al. (2006) empleando las mismas tareas, pero con bilingües altamente competentes en catalán y castellano, y con los mismos materiales adaptados para realizar una versión bilingüe en ambas direcciones de *priming* (i. e.: castellano-catalán y catalán-castellano). Ahora se pretendía explícitamente probar las propuestas del MJR y del MRD acerca de la asimetría en los efectos de *priming*. No obstante, como nuestros bilingües eran equilibrados en sus dos lenguas la predicción era que se esperaría observar efectos de *priming* significativos en las dos direcciones, y sin diferencias de magnitud entre ambas. Efectivamente así fue: los resultados mostraron claros efectos de *priming* tanto de traducción como semántico a través de lenguas en ambas direcciones y en las dos tareas empleadas. Más aún, la magnitud de los efectos no fue significativamente distinta en función de la dirección. Este resultado está en la línea de lo obtenido por Perea et al. (2008) con *priming* enmascarado y con bilingües con unas características parecidas a los estudiados aquí. Según el MJR, es un resultado esperable ya que los bilingües serían tan competentes en sus dos lenguas que podrían utilizar plenamente la ruta conceptual desde ambas lenguas. Según el MRD, las representaciones conceptuales que activarían las formas léxicas de ambas lenguas serían igual de ricas en este tipo de bilingües, de manera que los *primes* de una lengua provocarían una preactivación de los nodos semánticos muy similar tanto al estar escritos en castellano como al estarlo en catalán. Cabe destacar además que los resultados obtenidos en este trabajo son un reflejo de los obtenidos por Sánchez-Casas et al. (2006) con monolingües, ratificando así el alto nivel de competencia adquirido por los bilingües del estudio de Guasch et al. (2011).

Para concluir esta sección hace falta resaltar un último resultado con implicaciones teóricas interesantes. En los dos experimentos presentados en el artículo de Guasch et al. (2011) no sólo se observaron efectos de *priming* semántico de igual magnitud independientemente de la lengua del *prime*, sino que también se observaron efectos de *priming* de traducción de igual magnitud en ambas direcciones. Lo importante es que al comparar las magnitudes entre el *priming* de traducción y el *priming* semántico en su condición de relación semántica más cercana, las diferencias fueron significativas siendo mayor el *priming* de traducción. De esta manera se confirma una hipótesis más del MRD que planteaba que el *priming* de traducción debería ser mayor que el semántico, ya que un *prime* que es una traducción debería activar una cantidad de nodos semánticos muy parecida a la del *target*, mientras que un *prime* relacionado semánticamente únicamente activaría aquellos nodos por los cuales está relacionado conceptualmente con el *target*. Si tenemos en cuenta que el *priming* de repetición es un caso en el que el *prime* preactiva exactamente los mismos nodos que el *target* y donde los efectos de

priming serían máximos, y que el *priming* de traducción es la versión bilingüe más parecida al *priming* de repetición y ha demostrado causar efectos robustos en bilingües, ¿podríamos esperar que el grado de relación semántica entre palabras de distinta lengua modulara los efectos de *priming*?

3.1.3.- Influencia del grado de relación semántica entre palabras en el uso de las conexiones léxicas y conceptuales en el bilingüe

Para explorar hasta qué punto el grado en que dos palabras de la misma o de distinta lengua se encuentran relacionadas en su significado influye en los efectos de *priming* semántico o a la hora de traducir de una lengua a otra, tenemos que referirnos a los resultados de los cuatro artículos presentados en esta tesis. Comenzaremos repasando los datos obtenidos en monolingües con el paradigma de *priming* semántico, posteriormente analizaremos su equivalente bilingüe con los mismos materiales y tareas, y en último lugar comentaremos los resultados obtenidos con la tarea de reconocimiento de traducciones.

Anteriormente hemos comentado que en el trabajo de Sánchez-Casas et al. (2006) se seleccionó un conjunto de materiales relacionados semánticamente en los que se evitó explícitamente la asociación léxica de palabras, para no sesgar a los bilingües hacia el uso de una u otra ruta de traducción. Cabe señalar que además estos materiales incluían dos niveles distintos de relación semántica entre palabras: un nivel donde *prime* y *target* estaban relacionados de forma muy cercana (en el que según el MRD el número de nodos compartidos por ambas palabras sería muy alto) y un nivel de relación semántica cercana (en el que según el MRD el número de nodos compartidos por ambas palabras sería menor). Esta distinción se hizo precisamente para examinar si el grado de relación semántica entre palabras afectaba de algún modo al rendimiento de los participantes. Los resultados obtenidos por Sánchez-Casas et al. (2006) mostraron que el *priming* de repetición fue el que obtuvo una mayor magnitud, seguido del *priming* semántico en la condición muy cercana, y finalmente seguido por el *priming* semántico de la relación cercana. Este resultado se replicó en ambas tareas empleadas (i. e.: decisión léxica y categorización semántica) y nos permite concluir que efectivamente el grado de relación semántica modula los efectos de *priming* semántico en monolingües. Estos datos coinciden con los obtenidos previamente por Vigliocco et al. (2004) con la tarea de decisión léxica, pero no coinciden con los obtenidos por McRae y Boisvert (1998) con la tarea de decisión semántica. Recordemos que estos autores hallaron *priming* semántico en su condición más similar en significado, pero no en su condición menos similar. Es consistente con nuestros datos el hecho de que el grado de relación semántica module los efectos de *priming*; lo

que es inconsistente es que la condición menos cercana no muestre efectos significativos. No obstante, análisis posteriores de las características de nuestros materiales comparados con los empleados por McRae y Boisvert, demostraron que su condición de relación cercana estaba menos relacionada que la nuestra. Por lo tanto, no es tan anómalo el hecho de que no obtuvieran efectos de *priming* en la condición de relación cercana, y de todo ello podemos sacar una conclusión adicional: la existencia de un cierto grado de relación semántica que es necesario superar para que los efectos de *priming* se hagan patentes.

Para comprobar si la misma modulación se da también en bilingües cuando éstos son muy competentes en sus dos lenguas, hemos de centrarnos ahora en el trabajo de Guasch et al. (2011). Los resultados de este estudio fueron muy similares a los obtenidos por Sánchez-Casas et al. (2006): el *priming* de traducción (en sustitución del *priming* de repetición) mostró la mayor facilitación, seguido del *priming* semántico en la condición muy cercana, y después por el *priming* semántico en la relación cercana, tanto en la decisión léxica como en la semántica. De esta manera quedó demostrado que el grado de relación semántica modula los efectos de *priming* semántico también en bilingües cuando éstos están equilibrados en sus dos lenguas, lo cual está en consonancia con las predicciones del MRD. La única evidencia previa de esta modulación disponible en bilingües era la proveniente de los trabajos de Talamas et al. (1999) y de Sunderman y Kroll (2006) que habían empleado la tarea de reconocimiento de traducciones. Así pues, compararemos estos resultados de la literatura previa con nuestros resultados que han empleado la misma tarea.

Recordemos que en los estudios de Ferré et al. (2006) y de Guasch et al. (2008) se obtuvieron efectos de interferencia semántica únicamente con las relaciones semánticas muy cercanas. En cambio, en los estudio de Talamas et al. (1999) y de Sunderman y Kroll (2006), los bilingües competentes mostraban interferencia semántica independientemente del grado de relación semántica. Además de que sus análisis fueron realizados *a posteriori*, para explicar estas diferencias cabe recordar que nuestros materiales incluían únicamente relaciones semánticas puras. Un análisis de los materiales empleados por Talamas et al. y Sunderman y Kroll, reveló que la mayoría de los materiales empleados por estos autores incluían relaciones de asociación léxica entre palabras y, como se ha dicho anteriormente, ambos tipos de relaciones podrían reflejar el uso de distintos tipos de conexiones entre palabras. De hecho, existen evidencias en la literatura que muestran patrones distintos de *priming* semántico en función de si las relaciones entre palabras contienen asociación léxica o no (Bueno y Frenck-Mestre, 2002; Frenck-Mestre y Bueno, 1999; Kotz, 2001; Kotz y Elston-Güttler, 2004; Perea y Rosa, 2002; Sánchez-Casas, Ferré, Demestre, García-Chico y García-Albea, en revisión; Thompson-Schill

et al., 1998). En definitiva, las discrepancias entre nuestros resultados y los de Talamas et al. (1999) y de Sunderman y Kroll (2006) podrían ser una evidencia más del patrón diferencial de efectos que producen ambos tipos de relaciones entre palabras.

Finalmente, faltaría por explicar un último dato que se hace patente si miramos los cuatro artículos de esta tesis en conjunto: en la tarea de reconocimiento de traducciones solamente se encontraron efectos de interferencia con las relaciones semánticas más cercanas, mientras que en los experimentos realizados con el paradigma de *priming* se observaron efectos de *priming* significativos tanto en las relaciones muy cercanas como en las cercanas. Siguiendo el MRD, en el caso del reconocimiento de traducciones el hecho de que dos palabras compartan un gran número de nodos semánticos dificulta decidir que ambas palabras no son traducciones. Mientras que en el caso del *priming* semántico cuantos más nodos tengan en común las dos palabras, más nodos preactivados tendrá el *target* y más fácil será reconocer la palabra y tomar la decisión que requiera la tarea (ej., decidir si se trata de una palabra o no). Aunque los efectos sean en un caso de interferencia y en el otro de facilitación, el funcionamiento subyacente sería en esencia el mismo. Recientemente, Moldovan et al. (en prensa) han propuesto algunas posibles explicaciones para estas diferencias entre paradigmas. Una de ellas se basa en que mientras que la decisión léxica y la categorización semántica se llevan a cabo tomando una decisión sobre una sola palabra (i. e.: el *target*), el reconocimiento de traducciones requiere tener en cuenta ambas palabras, lo que seguramente se traduzca en un mayor coste de procesamiento semántico. Estas diferencias en cuanto a las demandas de las tareas quizá podrían explicar las diferencias en los resultados obtenidos con cada una de ellas. Otra explicación complementaria sugerida por Moldovan et al. (i. e.: hipótesis de la baja activación) sugiere que en los estudio de Ferré et al. (2006) y de Guasch et al. (2008) con reconocimiento de traducciones, el tiempo de presentación empleado (500 ms y 750 ms, respectivamente) podría ser excesivo si asumimos un decaimiento temporal de la activación. De esta manera, la activación provocada por las palabras con una relación semántica cercana podría haber desaparecido ya antes de que el participante hubiera tomado la decisión exigida por la tarea, no causando así interferencia ninguna. Moldovan et al. pusieron a prueba esta hipótesis reduciendo el tiempo de presentación en reconocimiento de traducciones a 250 ms, tiempo que coincide con el tiempo de presentación del *prime* de los estudios de Sánchez-Casas et al. (2006) y Guasch et al. (2011) con el paradigma de *priming* semántico. Los resultados en la condición de relación semántica cercana mostraron una interferencia de 20 ms en la dirección catalán–castellano y de 16 ms en la dirección castellano–catalán. Aunque estas diferencias no llegaron a ser significativas, sí se obtuvo una correlación significativa entre los juicios de similitud semántica y los efectos de interferencia, de manera que a mayor similitud entre dos palabras,

mayor la interferencia observada. Así, aunque los datos no corroboraron claramente la hipótesis de la baja activación, la correlación significativa observada tampoco nos permitiría descartarla, sugiriendo que el tiempo empleado de 250 ms seguiría siendo demasiado largo para poder captar claramente los efectos de interferencia. Emplear tiempos más cortos, o utilizar medidas de potenciales evocados (técnica destacada por tener una buena resolución temporal) serían vías interesantes de investigación futura.

3.1.4.- Conclusiones sobre los modelos de organización de la memoria bilingüe

Durante toda esta tesis hemos tomado como marco de referencia dos modelos clave para explicar cómo se encuentra organizada la memoria del bilingüe: el Modelo Jerárquico Revisado y el Modelo de Rasgos Distribuidos. Después de haber descrito las predicciones de ambos modelos y de repasar la evidencia experimental que los ponía a prueba, nos encontramos ya en disposición de hacer algunas reflexiones acerca de la validez de los mismos.

Comenzaremos por el MJR (Kroll y Stewart, 1994) por ser el primero históricamente y el modelo preponderante en los últimos años. Lo más importante de este modelo era su propuesta evolutiva: los bilingües aprendices se basan principalmente en la ruta léxica con la L1 para acceder de la L2 a los conceptos, y los bilingües competentes pueden acceder directamente al nivel conceptual desde ambas lenguas (véase Figura 2). Hemos empleado el paradigma de *priming* semántico y el paradigma de interferencia con la tarea de reconocimiento de traducciones, y hemos podido comprobar cómo, en general, las predicciones del modelo se cumplían: los bilingües aprendices mostraban una limitada influencia de las manipulaciones semánticas (señal de que empleaban más la ruta léxica), mientras que los competentes se veían más influidos por estas mismas manipulaciones (por su mayor uso de la ruta conceptual). No obstante, hay un resultado clave para el modelo que nosotros no hemos obtenido: una mayor influencia de las manipulaciones semánticas que de las formales en los bilingües más competentes. Si los bilingües competentes hacen un uso principal de la ruta conceptual, ¿por qué no hemos hallado sistemáticamente efectos de una magnitud mayor que la formal? Ya hemos hecho alusión anteriormente a este problema, y el estudio del contexto de adquisición podría tener la respuesta a la pregunta.

Pero revisando nuestros datos surgen más preguntas: ¿cómo podría acomodar el MJR la influencia de la edad de adquisición de la segunda lengua? La variable clave contemplada por el modelo es el nivel de competencia del bilingüe, pero hemos podido ver que la edad de adquisición también puede influir en la capacidad para acceder directamente al nivel conceptual.

Quizá se podría acomodar esta variable en el modelo en forma de una interacción con el nivel de competencia. Si el nivel de competencia determina la fuerza de la ruta conceptual, la edad de adquisición podría moderar esta fuerza en caso de tratarse de bilingües tardíos, o incrementarla en los bilingües tempranos. Para comprender mejor esta propuesta, imaginemos una hipotética multiplicación en la que el primer término sería el nivel de competencia, y el segundo la edad de adquisición. Ésta tomaría valores superiores a 1 en caso de una edad de adquisición temprana (el resultado aumentaría), o valores menores a 1 en caso de una edad de adquisición tardía (el resultado disminuiría).

Hasta este punto vemos que el modelo, con las dos explicaciones sugeridas (i. e.: contexto y edad de adquisición), da cuenta bastante bien de las evidencias obtenidas. Pero donde el MJR tiene realmente su punto débil es en la explicación de las variables que atañen al nivel semántico/conceptual: sencillamente el modelo no hace ninguna propuesta acerca de la organización de este nivel. Por lo tanto, tampoco permite hacer ninguna predicción del grado de relación semántica entre palabras, ni de ninguna otra variable referente a las palabras (ej.: concreción *vs*. abstracción, un significado *vs*. múltiples significados, etc.). En realidad, el problema del MJR respecto al nivel conceptual no es que su propuesta sea errónea, sino simplemente que no existe tal propuesta. Pero el margen de maniobra es grande y su imprecisión podría tornarse en ventaja, puesto que dentro de la 'caja' que representa al nivel conceptual tendrían cabida multitud de soluciones distintas. Sin embargo, es perentorio que el MJR detalle la organización en el nivel conceptual, sino quiere verse superado en poco tiempo por otras propuestas.

Un buen candidato a sucesor del MJR es precisamente el MRD (en la versión propuesta por Duyck y Brysbaert, 2004). ¿Cómo se adecúa este modelo a los datos aquí obtenidos? Recordemos que el MRD es ante todo parsimonioso: un único mecanismo permite explicar las asimetrías observadas entre aprendices y competentes, postulando que las representaciones de la L2 son menos detalladas que las de la L1 en los menos competentes, e igual de ricas en los más competentes (véase Figura 6). En este sentido las predicciones serían las mismas que las del MJR: los bilingües competentes, al tener representaciones ricas en la L2, mostrarían interferencia o facilitación semántica desde esta lengua, mientras que los aprendices mostrarían efectos semánticos limitados ya que sus representaciones en su L2 activarían un número de nodos reducido. Respecto a la influencia de las manipulaciones de forma, el MRD no es explícito en cuanto al nivel léxico, pero es de suponer que en un sistema léxico integrado las palabras parecidas en la forma se activen entre ellas, de manera que lo que se esperaría es exactamente lo que hemos observado aquí: que independientemente del nivel de competencia

de los bilingües, se observaran influencias de las manipulaciones formales (ya sean en forma de *priming* o de interferencia) con independencia de la magnitud de los efectos semánticos.

Respecto a la edad de adquisición, tampoco está contemplada en el MRD, pero podríamos acomodarla de forma similar a como hemos propuesto en el MJR: la riqueza de las representaciones en el nivel semántico no dependería solamente del nivel de competencia del bilingüe, sino de éste en interacción con la edad de adquisición de la segunda lengua.

Finalmente, donde el MRD tiene realmente su punto fuerte es en la descripción del nivel semántico conceptual, ya que en un punto donde el MJR no hacía ninguna predicción, el MRD ha sido capaz de dar cuenta de todos nuestros resultados: los mayores efectos de interferencia en la traducción que en las relaciones semánticas, y la gradación de efectos (ya sea de *priming* o de interferencia) en función del grado de relación semántica entre palabras.

Por todo ello, pensamos que el MJR sigue siendo muy útil para explicar cómo el bilingüe organiza la información de sus léxicos, pero el modelo debería detallarse más en algunos aspectos. Una propuesta alternativa es el MRD, que ofrece un mecanismo de organización más sencillo que el del MJR para explicar los datos, y a la vez resulta más potente, ya que puede dar cuenta de otras muchas variables relativas a las palabras (ej.: diferencias entre palabras cognadas y no cognadas, palabras concretas frente a abstractas, efectos de las traducciones múltiples, etc.).

3.2.- Conclusiones

- Claramente, los bilingües muy competentes son capaces de acceder directamente al nivel conceptual desde sus dos lenguas. Sin embargo, las conexiones entre lenguas en el nivel léxico no desaparecen con el aumento en el nivel de competencia. El MJR propone que en estos bilingües la magnitud de la interferencia semántica debería ser mayor que la interferencia formal, pero nuestros datos no han confirmado esta predicción.

- Los aprendices en las etapas iniciales de aprendizaje de su segunda lengua, son capaces de acceder directamente al nivel conceptual desde la L2, aunque de una forma limitada. De todos modos, los efectos de interferencia formal en aprendices son claramente superiores a las señales de mediación conceptual que puedan mostrar, lo cual corrobora las predicciones del MJR. Parece necesario adquirir cierto nivel de competencia para mostrar una mediación conceptual sólida desde la L2. Sin embargo, esta mediación se da ya en niveles intermedios de aprendizaje.

- El nivel de competencia del bilingüe es una variable de peso que determina la posibilidad de acceder directamente al nivel conceptual. Aunque de menor importancia, la edad de adquisición también es un factor a tener en cuenta. Los modelos de organización de la memoria bilingüe deberían contemplar esta variable en sus supuestos teóricos.

- Es necesario explorar con mayor detalle el papel del contexto de adquisición de la segunda lengua, ya que podría explicar algunos resultados experimentales discrepantes, como por ejemplo la presencia o ausencia de diferencias en magnitud entre la interferencia formal y la semántica en bilingües muy competentes, los indicios de un acceso directo al nivel conceptual desde la L2 en aprendices de la segunda lengua o la interacción entre competencia y edad de adquisición.

- Es posible observar claros efectos de *priming* semántico empleando relaciones semánticas sin asociación léxica, tanto en monolingües, como en bilingües muy competentes en sus dos lenguas. Los bilingües equilibrados en sus dos lenguas son sensibles al *priming* semántico tanto si éste se produce desde la L1 como si lo hace desde la L2. Además, la sensibilidad que muestran es de la misma magnitud en ambos casos, confirmando así las predicciones del MJR y del MRD.

- Tal y como se esperaría desde el MRD, el *priming* de traducción produce efectos de *priming* de mayor magnitud que el *priming* semántico, ya que el número de rasgos compartidos por *prime* y *target* también es mayor en el caso de la traducción. Más aún, el grado de relación semántica entre dos palabras modula los efectos de *priming* semántico en monolingües, aunque es necesario un grado mínimo de relación para que los efectos de *priming* sean detectables. En consonancia con las predicciones del MRD, el grado de relación semántica entre dos palabras modula también los efectos de *priming* semántico en bilingües cuando éstos están equilibrados en sus dos lenguas.

- Es necesario explorar con mayor detalle el papel del tipo de relaciones entre palabras, ya que el patrón de efectos de *priming* semántico parece ser distinto en función de si los materiales están relacionados semánticamente sin asociación, o si incluyen también asociación léxica. También es necesario explorar el curso temporal de la activación provocada por los *primes* relacionados semánticamente con el fin de determinar si las relaciones menos cercanas son capaces de provocar interferencia semántica. Los potenciales evocados son una buena manera de explorar esta cuestión.

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