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Factores de riesgo implicados

en el comportamiento agresivo

del perro y del gato

Memoria presentada por **Marta Amat Grau**

para optar al grado de Doctora en Veterinaria

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CERTIFIQUEN:

Que la memòria titulada "**Factores de riesgo implicados en el comportamiento agresivo del perro y del gato**", presentada per **Marta Amat Grau** per optar al grau de Doctora en Veterinària, ha estat realitzada sota llur direcció i, considerant-la acabada, autoritzen la seva presentación per tal que sigui jutjada per la comissió corresponent.

I perquè consti als efectes oportuns, signen el present certificat a Bellaterra, a 3 de desembre de 2010.

Dr. Xavier Manteca i Vilanova   Dr. José Luis Ruiz de la Torre Casañas

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INTRODUCCIÓN GENERAL

1.Justificación del estudio de la agresividad canina y felina

El estudio de la agresividad canina y felina es importante por varios motivos. En primer lugar, los problemas de agresividad del perro (*Canis familiaris* o *Canis lupus familiaris*) y del gato (*Felis silvestris catus*) son muy frecuentes (Beaver, 1994; Lund et al., 1996; Reisner, 2003; APBC, 2005; Barberger y Houpt, 2006; Fatjó et al., 2007) y, al menos en los centros de referencia, son el principal problema de comportamiento. A modo de ejemplo, según los datos recogidos por la APBC (Association of Pet Behaviour Counsellors), el 56.4 % de los perros y el 32 % de los gatos han sido tratados alguna vez por un problema de agresividad (APBC, 2005). Además, todos los autores coinciden en que el número de accidentes por mordedura ha aumentado en los últimos años (Wright, 1990a; Wright, 1990b; Stull y Hodge, 2000). Este incremento es debido, en parte, al aumento del número de perros y gatos (U.S. Pet Ownership and Demographics Sourcebook, 2007). Además, aunque hay diferencias entre países, la población es cada vez más sensible a este problema, lo que resulta en un mayor número de denuncias (Szpakowski et al., 1989).

Los accidentes causados por mordeduras de perros y gatos son un problema de salud pública (Goldstein, 1992; Palacio et al., 2005; Palacio et al., 2006) y concretamente las mordeduras de perro constituyen el riesgo más grave que estos animales suponen para la salud de las personas. En 1994, se estimó que el 1.8% de la población de EEUU había sido mordida alguna vez por un perro (Sacks et al., 1996a). A los costes económicos derivados del tratamiento de las lesiones físicas debemos añadir las secuelas psicológicas que muchas veces aparecen tras las agresiones. En EEUU el coste de las mordeduras de perros asciende a 30-100 millones de dólares al año (Berzon et al., 1972; Matter y Arbeitsgemeinschaft, 1998; Weiss et al., 1998; Borud y Friedman, 2000).

Los accidentes por mordedura son potencialmente graves y afectan de forma desproporcionada a los niños. En EEUU por ejemplo, entre 1989 y 1994 murieron 109 personas por mordeduras de perros, 57% de las cuales fueron niños menores de 10 años (Sacks et al., 1996a). El blanco más frecuente de los ataques de perros son los niños varones (Berzon et al., 1972; Morton, 1973; Gershman et al., 1994; Sacks et al., 1996b; Ozanne-Smith et al., 2001). En España, por ejemplo, los niños menores de 14 años tienen un riesgo 4 veces superior de sufrir una agresión que el resto de la población y los niños varones tienen a su vez un riesgo 1.4 veces mayor que las niñas (Palacio et al., 2005).

Aunque las mordeduras de gatos son menos frecuentes que las mordeduras de perros, las consecuencias negativas derivadas de las mismas son más probables en la especie felina como consecuencia de la población de microorganismos presentes en la saliva de estos animales (Matter y Arbeitsgemeinschaft, 1998; Goldstein, 1999). En la especie felina también son los niños el sector de población más afectado, aunque parece ser que, contrariamente a lo que ocurre con las mordeduras de perros, las niñas tienen un riesgo mayor que los niños (Wright, 1990a; Palacio et al., 2006).

La agresividad del perro y del gato también es importante, porque constituye una de las principales causas de eutanasia y abandono de perros y gatos sanos (Reisner et al., 1994; Overall, 1997; Edney, 1998; Salman et al., 1998; Heath, 2007). En un estudio realizado en EEUU, el 47% de los propietarios que habían dado su mascota en adopción citaban un problema de comportamiento como la causa principal de su decisión (Scarlett et al., 1999).

A las razones citadas anteriormente debemos añadir que la mayoría de los problemas de agresividad afectan negativamente al bienestar del animal (Stafford, 2007). Con excepción de la agresividad depredadora -que resulta placentera para el animal-, las otras formas de agresividad (ver más adelante) estimulan los centros nerviosos responsables del castigo, es decir, generan un estado afectivo negativo y, además, van

acompañadas de una respuesta de estrés. Cuando dicha respuesta es crónica o se repite muy frecuentemente, el bienestar de los animales disminuye (Overall, 1997; Broom y Johnson, 1993; Moberg, 2000).

2.Biología de la conducta agresiva

La agresividad se define como aquel comportamiento que tiene como objetivo provocar daño físico a otro individuo (Moyer, 1968). Se trata de un comportamiento muy complejo que depende de numerosos factores (Brain, 2000; Nelson, 2006) cuya identificación es imprescindible para desarrollar medidas de prevención.

2.1.Factores que influyen en la manifestación de la conducta agresiva

La manifestación de la conducta agresiva es el resultado de la interacción entre varios factores internos y externos. Entre estos factores destacan los siguientes:

- Cambios en la actividad de varios neurotransmisores
- Cambios en la concentración plasmática de varias hormonas
- Estrés
- Aprendizaje
- Patologías

2.1.1.Neurotransmisores.

El neurotransmisor más involucrado en el comportamiento agresivo es la serotonina (Berman y Coccaro, 1998; Miczek y Fish, 2006). La serotonina es una monoamina sintetizada a partir del triptófano, que es un aminoácido esencial. Las neuronas serotoninérgicas están muy extendidas en el sistema nervioso central. Se originan en el núcleo del rafe del tronco encefálico y proyectan sus axones hasta diversas áreas del cerebro, incluyendo áreas subcorticales (tálamo, ganglios basales, hipotálamo,

hipocampo, amígdala y septum) y la corteza. Además las neuronas serotoninérgicas inervan zonas del sistema nervioso que contienen neuronas dopaminérgicas y noradrenérgicas, modulando así la respuesta originada por dichos neurotransmisores (Manuck et al., 2006).

Hay al menos tres evidencias que ponen de manifiesto la relación de la serotonina con el comportamiento agresivo. En primer lugar, varios estudios han demostrado una correlación negativa entre la actividad de la serotonina en el sistema nervioso central y el comportamiento agresivo (Giacalone et al., 1968; Brown et al., 1979; Mehlman et al., 1995; Berman et al., 1997). Así, por ejemplo, en uno de los primeros estudios acerca de la relación entre serotonina y agresividad se observó que los ratones (Mus musculus) que estaban aislados y eran agresivos tenían niveles más bajos de serotonina (5-HT) y ácido 5-hidroxiindolacético (metabolito principal de la serotonina; 5-HIAA) que los no agresivos y estabulados en grupo (Giacalone et al., 1968). En humanos, los individuos que sufren un desorden de personalidad caracterizado por un comportamiento violento tienen niveles de 5-HIAA en el líquido cefalorraquídeo más bajos que los del grupo control (Brown et al., 1979).

En segundo lugar, la administración de fármacos que aumentan la actividad de la serotonina disminuye la agresividad (Coccaro et al., 1990; Fava et al., 1996; Ferris et al., 1999). Finalmente, la administración de una dieta baja en triptófano que, recordemos, es el aminoácido precursor de la serotonina, aumenta la conducta agresiva (Young, 1991).

Estudios recientes han investigado la relación entre el comportamiento agresivo y los polimorfismos en los genes que controlan el transporte, la síntesis o el metabolismo de la serotonina. Por ejemplo, un estudio realizado con niños que presentaban una historia de comportamiento muy agresivo durante al menos 2 años encontró una asociación significativa entre un polimorfismo en uno de los genes responsables del transporte de la serotonina y la agresividad (Beitchman et al., 2006).

Además de la serotonina, otros neurotransmisores monoaminérgicos como la noradrenalina o la dopamina están involucrados también en el comportamiento agresivo. A modo de ejemplo, estudios realizados con ratones knock-out en los que se ha alterado el sistema noradrenérgico, se ha observado un incremento del comportamiento agresivo (Haller et al., 2002). La destrucción de neuronas dopaminérgicas se correlaciona con una reducción de la agresividad de tipo ofensivo y con un aumento de la agresividad defensiva (Pucilowski et al., 1982; Champagne et al., 2004).

Aunque en menor medida, el glutamato y el ácido gamma-aminobutírico (GABA) están también involucrados en la regulación del comportamiento agresivo. El glutamato se relaciona principalmente con la agresividad de tipo defensivo (Siegel et al., 1999). En varias especies, los individuos más agresivos muestran una menor actividad del GABA en el sistema nervioso central, lo que sugiere un papel inhibitorio del GABA sobre el comportamiento agresivo (Guillot y Chapouthier, 1998).

2.1.2. Hormonas.

Las hormonas aumentan o disminuyen la probabilidad de que un determinado comportamiento se manifieste, siempre y cuando las condiciones sean las adecuadas (Nelson, 2000a).

Está ampliamente documentado que en la mayoría de especies los machos son más agresivos que las hembras (Moyer, 1968; Nelson, 2000b). Una de las hormonas con efectos más marcados sobre el comportamiento agresivo es la testosterona (Nelson, 2000b). En efecto, algunas formas de agresividad aparecen cuando los individuos llegan a la pubertad y la castración disminuye la presentación de determinados tipos de agresividad de tipo ofensivo (por ejemplo, la agresividad entre machos). Además, la estacionalidad de la agresividad observada en algunas especies coincide con las variaciones en la concentración de testosterona (Nelson, 2000b). En algunas especies

como la rata de laboratorio (Rattus norvegicus), los individuos más agresivos tienen una concentración plasmática de testosterona mayor que los individuos menos agresivos (Nelson, 2000b). En cambio, no se observa dicha correlación en otras especies como por ejemplo el ratón (*Mus musculus*) (McKinney y Desjardins, 1973; Schuurman, 1980). Estas diferencias podrían ser debidas a una sensibilidad diferente de los receptores de testosterona en ambas especies (Nelson, 2000b).

La relación existente entre la testosterona y el comportamiento agresivo es bidireccional, es decir, la concentración de testosterona modifica la probabilidad de que se muestre comportamiento agresivo y, a su vez, la agresividad causa en ocasiones un aumento de la testosterona (Nelson, 2000a). Por ejemplo, en algunas especies de pájaros la visión de un intruso en el territorio provoca la elevación de los niveles de testosterona que a su vez desencadenará el canto o la agresividad (Wingfield, 1988). En primates, la concentración de testosterona aumenta en los individuos que resultan vencedores tras una interacción agonística o una competición y disminuye, en cambio, en los individuos que salen derrotados (Mazur y Lamb, 1980; Bernhardt et al., 1998).

Concentraciones elevadas de testosterona se correlacionan con niveles reducidos de serotonina y parece ser que la testosterona modula la actividad de los receptores serotoninérgicos. Por ejemplo, en la rata, los tratamientos prolongados con testosterona reducen los niveles de serotonina ya que incrementan la cantidad de serotonina unida al receptor 5- HT1A tanto en el hipotálamo como en el hipocampo (Bonson et al., 1994). En el ratón también se ha observado que la testosterona tiene modifica la sensibilidad de los receptores HT1A y HT1B serotoninérgicos, que son los más implicados en el comportamiento agresivo (Cologer-Clifford et al., 1999).

Aunque tal como hemos comentado en la mayoría de especies el macho es más agresivo que la hembra, en algunas especies como la hiena manchada (*Crocuta crocuta*), el andarrío (*Actitis macularius*) y el hámster común (*Mesocricetus auratus*), las

hembras son más agresivas que los machos (Payne y Swanson, 1972; Fivizzani y Oring, 1986).

2.1.3.Estrés.

La relación entre el estrés y la agresividad está muy bien documentada. El incremento de la actividad del eje hipotálamo-hipófisis-adrenales como consecuencia de un evento estresante puede desencadenar agresividad y, a su vez, la estimulación del área del hipotálamo que controla la agresividad desencadena la respuesta de estrés (Kruk et al., 2004).

La exposición a estímulos estresantes a una edad temprana puede influir de forma muy marcada y permanente sobre el comportamiento posterior de un animal (Lay, 2000; Ladd et al., 2004). Por ejemplo, un estudio llevado a cabo en ratones demostró que si las crías son apartadas de su madre unos 15 minutos cada día a lo largo de las dos primeras semanas de vida, la madre responde lamiendo a las crías con más frecuencia e intensidad cuando éstas son devueltas al nido. Esto, a su vez, hace que las crías muestren a lo largo de toda su vida una mayor capacidad de controlar la intensidad de su respuesta de estrés que las crías que no habían sido separadas de su madre. Según parece, la estimulación táctil que proporciona el lamido induce cambios epigenéticos que dan lugar a un aumento del número de receptores de glucocorticoides en el hipocampo, aumentando así la capacidad para regular la respuesta de estrés (Meaney, 2001; Seckl, 2004; Holmes et al., 2005).

Por otro lado, un estrés muy intenso puede alterar la estructura del hipocampo y resultar en una menor capacidad para regular la intensidad de la respuesta de estrés (Weaver et al., 2004). Así, por ejemplo, un estudio realizado en pacientes con depresión demostró que los individuos que sufrieron algún tipo de trauma en la infancia muestran una hiperactividad del eje hipotálamo-hipófisis-adrenales, una reducción del

tamaño del hipocampo y alteraciones neuronales en la corteza prefrontal (Holmes et al., 2005).

2.1.4.Socialización.

La etapa en el desarrollo del cachorro más importante desde el punto de vista del comportamiento es el periodo de socialización. En el perro, este período se inicia a las 3 semanas de edad –cuando el cachorro es capaz de interaccionar con el entorno- y acaba a las 12-14 semanas de edad- cuando la respuesta de miedo condiciona el comportamiento del cachorro- (Scott y Fuller, 1965). En el gato, el periodo de socialización comprende desde las 2 hasta la 9 semana de vida (Karsh, 1983). Si durante esta fase, el cachorro es separado prematuramente de la madre y/o no tiene un contacto suficiente con otros animales de su especie y con personas, una vez adulto puede manifestar problemas de miedo y/o agresividad (Beaver, 2009).

2.1.5.Aprendizaje.

Un perro puede aprender a reaccionar con agresividad a través de un adiestramiento pero también puede reforzarse dicho comportamiento como resultado del manejo de los propietarios y de la experiencia. De todas las formas de aprendizaje, el condicionamiento operante es el que puede tener un efecto más marcado sobre la conducta agresiva (Lindsay, 2001). La agresividad del perro puede verse reforzada si el perro es recompensado después de mostrar conducta agresiva. Además, el perro puede aprender a evitar un estímulo aversivo respondiendo con agresividad (Azrin et al., 1965). Por lo tanto, el aprendizaje juega un papel primordial en la mayoría de problemas de agresividad (Moyer, 1968; Beaver, 2009).

2.1.6.Patologías.

Diversas enfermedades pueden causar un cambio de comportamiento y, más concretamente, agresividad. Un cambio brusco del comportamiento, un patrón de conducta inconsistente o una falta de respuesta desfavorable al tratamiento pueden ser indicativos de un problema médico (Hunthausen et al., 1994).

- **Disfunción de la corteza prefrontal**

  Las emociones no están solo controladas por las estructuras del sistema límbico como el hipotálamo o la amígdala, sino también por la corteza prefrontal (Bechara et al., 2000). En las personas, una disfunción del lóbulo prefrontal puede causar agresividad en pacientes con problemas neurológicos y psiquiátricos (Giancola, 1995; Gansler et al., 2009). Varios estudios realizados en roedores y primates no humanos obtuvieron los mismos resultados. Por ejemplo, las ratas macho a las que se les había lesionado la corteza prefrontal mostraban mayor agresividad y una mayor actividad que los animales del grupo control (Bruin et al., 1983).

- **Hidrocefalia**

  Los síntomas clínicos de esta patología dependen de la zona del cerebro afectada por el incremento de presión. La agresividad es un síntoma que aparece con relativa frecuencia y según algunos autores la agresividad por hidrocefalia supone alrededor de un 0.8% de los problemas de agresividad del perro (Beaver, 1983).

- **Dolor**

  El dolor puede desencadenar una respuesta agresiva a través de dos mecanismos. Por un lado, mediante un mecanismo de evitación ya que el animal puede reaccionar con agresividad para evitar una determinada manipulación que anteriormente le había ocasionado dolor (Grant, 2006; Seibert y Landsberg,

2008). Además, el dolor crónico causa una disminución de la actividad serotonérgica, lo que se traduce en un aumento de la agresividad (Mellor et al., 2000). Los problemas de agresividad relacionados con el dolor constituyen aproximadamente el 2-3 % de los problemas de agresividad (Beaver, 1983; Borchelt, 1983).

- **Hipotiroidismo**

  En el perro, algunos casos de hipotiroidismo cursan únicamente con agresividad (Overall, 2003). El mecanismo fisiológico no se conoce con exactitud, aunque se ha sugerido que la disminución de la concentración plasmática de hormonas tiroideas causa una la disminución en la actividad de la serotonina (Kulikov y Zubkov, 2007).Algunos estudios concluyen que los problemas de hipotiroidismo suponen un 1.7% del total de los problemas de agresividad del perro (Reinhard, 1978; Beaver, 1983).

3.Tipos de agresividad: clasificación biológica y clínica

La forma más objetiva de clasificar la agresividad es teniendo en cuenta la existencia o no de activación simpática (Blanchard y Blanchard, 2006). Según este criterio, podemos dividir la agresividad en afectiva y no afectiva. En la agresividad de tipo afectivo se produce una marcada activación autonómica y la participación de estructuras como la corteza frontal o la amígdala. En la agresividad de tipo no afectivo (también llamada no emocional o depredadora), no se produce una activación simpática (Beaver, 2009). Esta agresividad se desencadena con el movimiento de la presa y los ataques suelen ser silenciosos (Houpt, 1998). La estimulación eléctrica del hipotálamo lateral desencadena agresividad depredadora (Weinshenker y Siegel, 2002).

La agresividad afectiva se divide a su vez en agresividad ofensiva –que tiene como objetivo la obtención y/o la protección de un recurso- y la agresividad defensiva –que

tiene como objetivo escapar de un estímulo que resulta amenazante- (Blanchard y Blanchard, 1984; Luescher y Reisner, 2008). En el caso de la agresividad afectiva, los animales adoptan una postura característica (ver más adelante) y a menudo producen sonidos característicos (Beaver, 2009).

En la agresividad ofensiva –controlada en parte por el área medial del hipotálamo- el animal mantiene el cuerpo erguido, las extremidades extendidas, las orejas erguidas y hacia adelante, la cola levantada, la mirada fija y los labios retraídos mostrando solo los incisivos y los caninos (Fox y Bekoff, 1975; Ferris et al, 1997; Blanchard y Blanchard, 2006). En la agresividad defensiva – controlada en parte por el hipotálamo dorsal (Flynn et al., 1970)- el animal mantiene el cuerpo agachado, con las orejas hacia atrás, la cola baja, el pelo del lomo erizado y los labios retraídos mostrando también los molares   (Fox y Cohen, 1977; Houpt, 1998).

En el caso del gato, la postura ofensiva es menos característica ya que es muy parecida a la postura "normal" del gato. En ocasiones podemos observar piloerección, orejas hacia delante, cola erizada, bufidos y gruñidos. Por el contrario, cuando un gato reacciona con miedo, suele mantenerse agachado o con la columna arqueada, con las orejas hacia atrás, la cola cerca del tronco o en forma de U invertida; en ocasiones podemos observar piloerección, bufidos y vocalizaciones (Leyhausen, 1979).

La clasificación biológica es la más objetiva, pero en la clínica diaria no es demasiado práctica. Por ello, los especialistas han desarrollado diferentes clasificaciones basadas en el blanco de los ataques, el contexto en que se produce la agresión y la postura que adopta el animal durante el episodio agresivo (Reisner, 2002). Todas las clasificaciones derivan de la clasificación introducida por Moyer en 1968, en la que se distinguen ocho formas básicas de agresividad (tabla 1).

Aunque existen muchas clasificaciones clínicas de la agresividad, las diferencias parecen deberse en gran medida a un problema de terminología (Overall, 1997;

Beaver, 2009). Así, por ejemplo, algunos autores consideran la agresividad redirigida del gato como una categoría aparte, mientras que otros autores consideran que todos los tipos de agresividad pueden redirigirse (Moyer, 1968; Reisner, 2002).

Tabla 1: Tipos de agresividad según Moyer (1968)

Por irritabilidad
Territorial
Entre machos
Motivada por miedo
Depredadora
Maternal
Relacionada con el sexo
Instrumental

4.La agresividad como problema de salud pública: factores de riesgo

Anteriormente se ha comentado la importancia de los problemas de agresividad desde el punto de vista de salud pública. Pues bien, las consecuencias de un accidente por mordedura dependen de varios factores, incluyendo el tamaño del animal (especialmente en el caso del perro), la intensidad del ataque y la impulsividad. La impulsividad se define como la falta o la reducción de las señales de aviso que habitualmente preceden a un ataque (Peremans, 2003). En efecto, la secuencia de ataque incluye normalmente un conjunto de señales de amenaza o de aviso como, por ejemplo, gruñir (Bowen y Heath, 2005). Sin embargo, en ocasiones los animales pueden morder sin mostrar señales previas de amenaza; en estos casos la agresividad se considera impulsiva. La impulsividad aumenta el riesgo que supone convivir con un perro o un gato agresivos (Reisner, 1994).

En el perro y muy especialmente en algunas razas como por ejemplo el Cocker Spaniel Inglés (CSI), se ha descrito una forma de agresividad hacia los miembros de la familia que se carcteriza por ser muy impulsiva (Landsberg, 1991; Beaver, 1994; Pageat, 1998). Algunos autores opinan que se trata de una forma particular de agresividad competitiva hacia los miembros de la familia (Neville, 1991; Reisner, 1996; Pageat, 1998). Otros autores, por el contrario, sugieren que sería consecuencia de un problema médico, sobre todo cuando los ataques se producen aparentemente sin un estímulo desencadenante (Beaver, 1980; Colter, 1989; Dodman et al., 1992).

En el gato, la agresividad redirigida se caracteriza también por su impulsividad. La agresividad redirigida se caracteriza porque el animal dirige su agresividad hacia un estímulo que no es el responsable de la motivación agresiva. Este estímulo alternativo puede ser un objeto, una persona o bien otro gato (Beaver, 2003).Los sonidos intensos y la presencia de otros gatos son los estímulos detonantes implicados más frecuentemente en la agresividad redirigida (Chapman y Voith, 1990).

Las causas de la agresividad redirigida no se conocen con certeza, pero algunos estudios sugieren que podría servir para reducir la respuesta de estrés. Así, en un estudio realizado en babuinos (*Papio anubis*) se observó que, tras perder una pelea, algunos individuos atacan a un subordinado que no estaba involucrado en el conflicto inicial (Sapolsky y Virgin, 1997). Parece ser que los individuos que muestran agresividad redirigida tienen una concentración plasmática de cortisol inferior a la de los que no muestran agresividad redirigida (Sapolsky y Ray, 1989; Virgin y Sapolsky, 1997). Igualmente, en algunas especies de roedores, felinos y primates, se ha observado que los animales sometidos a un shock eléctrico muestran agresividad hacia otros animales (Azrin et al., 1967).

Tal como se ha comentado, la impulsividad aumenta considerablemente la peligrosidad de un animal. Por lo tanto, es importante saber por qué en ocasiones los individuos reaccionan con impulsividad. Sin embargo debemos tener en cuenta que en ocasiones

no se trata realmente de una reacción impulsiva. En efecto, a veces el propietario no es capaz de describir correctamente la secuencia del ataque y describe un ataque como impulsivo cuando en realidad no lo es. Se ha demostrado que muy a menudo los propietarios de perros olvidan algunas de las señales previas al ataque o simplemente no las consideran parte de la secuencia de conducta agresiva (Correia et al., 2007).

Además otros autores han sugerido que en algunas razas, los cambios morfológicos derivados del proceso de selección y domesticación son responsables de la desaparición de algunas señales, de forma que el ataque aparece como impulsivo (Fox, 1971; Goodwin et al., 1997).

4.1. Factores relacionados con la impulsividad:

4.1.1. Serotonina.

Una actividad reducida de la serotonina aumenta el riesgo de impulsividad (Soubrié, 1986; Coccaro, 1989; Virkkunen y Linnoila, 1993). En humanos, por ejemplo, los individuos violentos e impulsivos tienen una concentración menor de ácido 5-hidroxiindolacético (5-HIAA), en el líquido cefalorraquídeo que los individuos que habían cometido un crimen con premeditación (Virkkunen et al., 1995). La 5-HIAA es el principal metabolito de la serotonina. Además, los inhibidores de la recaptación de serotonina, que aumentan la actividad de dicho neurotransmisor, reducen la impulsividad (Weaver y Clum, 1993; Coccaro y Kavoussi, 1997; Cherek y Lane, 1999).

Los perros con agresividad por dominancia tienen una concentración de 5-HIAA en el líquido cefalorraquídeo menor que los perros no agresivos y esta diferencia es más marcada cuando se comparan perros impulsivos con perros no impulsivos (Reisner et al., 1996). En otras especies, una concentración reducida de 5-HIAA también se asocia a un comportamiento impulsivo (Mehlman et al., 1994; Higley et al., 1996).

Algunos polimorfismos genéticos están relacionados con la actividad de varios neurotransmisores y con la impulsividad. Así, por ejemplo, se ha identificado una una mutación en el gen que codifica la monoamino oxidasa A (MAO-A) en gemelos del sexo masculino que manifestaban impulsividad (Brunner et al., 1993); la MAO-A es una enzima que participa en el metabolismo de la serotonina, dopamina y noradrenalina. En perros de raza Pastor Alemán se observó una correlación entre polimorfismos en el gen del receptor D4 de la dopamina y un rasgo de carácter que los autores llamaron "actividad-impulsividad" (Hejjas et al., 2007).

4.1.2.Alteraciones en la corteza prefrontal.

La corteza orbito-frontal está implicada en la modulación de la respuesta agresiva (Blair et al., 2006). Por ejemplo, los pacientes que han sufrido un accidente cerebrovascular o una herida que ha lesionado el lóbulo frontal pueden manifestar un comportamiento social inapropiado y desinhibido; además, reaccionan de forma impulsiva y exagerada a una provocación (Scarpa y Raine, 2006).

4.1.3.Aprendizaje.

En ocasiones la impulsividad puede ser resultado del aprendizaje y se ha sugerido que los animales pueden aprender a suprimir las señales de amenaza cuando éstas no les suponen ninguna ventaja (Pageat, 1998).

5.La agresividad canina como modelo para el estudio de las diferencias individuales

El perro es un modelo interesante para estudiar varios problemas de interés general. En efecto, a diferencia de lo que ocurre con otras especies, el genoma del perro se ha secuenciado (Parker et al., 2004). Además, el perro doméstico es el mamífero más diverso en cuanto a tamaño y morfología y es más probable que la diversidad en

cuanto a comportamiento sea también notable. Por estas dos razones el perro es un modelo excelente para estudiar las causas responsables de las diferencias individuales en conducta.

Un punto adicional a tener en cuenta es que los problemas de agresividad en el perro se presentan con mucha frecuencia (Beaver, 1994; APBC, 2005; Fatjó et al., 2007). Este hecho facilita su estudio y, además, permite prescindir de los procedimientos experimentales que se realizan en otras especies y que pueden tener limitaciones económicas y relacionadas con el bienestar de los animales de experimentación.

5.1.Raza.

El primer estudio que se llevó a cabo con el objetivo de caracterizar las posibles diferencias de comportamiento entre razas fue realizado por Scott y Fuller a mediados del siglo pasado. Estos autores observaron diferencias entre las cinco razas estudiadas (Basenji, Fox Terrier de pelo duro, Beagle, Cocker Spaniel y Pastor de Shetland) para todos los comportamientos, incluyendo la agresividad (Scott y Fuller, 1965).

Más adelante, Hart y Hart (1985) concluyeron que hay diferencias significativas entre las razas en todos los rasgos de carácter incluidos en su estudio (tabla 2). Un aspecto importante es que la raza resultó tener un valor predictivo más alto para algunos caracteres que para otros. Por ejemplo, la raza predice en buena medida el nivel general de actividad, mientras que predice en menor medida la facilidad de aprendizaje. Esto es debido a que algunos caracteres muestran una gran variabilidad dentro de cada raza, de modo que ésta pierde valor predictivo (Hart y Hart, 1985).

Tabla 2. Características de comportamiento ordenadas de mayor a menor valor predictivo de la raza (cuanto mayor es el valor F, mayor es el valor predictivo de la raza para la característica en cuestión) (Hart y Hart, 1985).

Característica de comportamiento	Valor F
Excitabilidad	9.6
Actividad general	9.5
Agresividad hacia los niños	7.2
Ladrido excesivo	6.9
Conducta de juego	6.7
Facilidad para el entrenamiento de obediencia	6.6
Ladrido de alarma	5.1
Agresividad hacia otros perros	5.0
Dominancia hacia el propietario	4.3
Defensa del territorio	4.1
Demanda de atención	3.6
Conducta destructiva	2.6
Aprendizaje de los hábitos de eliminación	1.8

El estudio de polimorfismos genéticos también aporta información acerca de las diferencias entre razas en determinados rasgos de comportamiento. Por ejemplo, los Golden Retriever y los Shiba muestran diferencias en la región polimórfica del gen del receptor 4 de la dopamina y estas diferencias podrían explicar las diferencias de comportamiento entre ambas razas (Niimi et al., 1999).

También existen diferencias entre individuos dentro de una misma raza. Por ejemplo, se ha observado, que en varias especies los individuos de un determinado color de capa difieren en su comportamiento en comparación con los de otra capa. Así, por ejemplo, las ratas macho de capa negra son más dóciles que los machos de capa agutí

(Keeler, 1942; Cottle y Price, 1987). Igualmente, los gatos de capa negra son más dóciles con los humanos que los de capa agutí (Hemmer, 1990). En el perro, y más concretamente en el Labrador y en el Cocker Spaniel Inglés, hay varios estudios que demuestran que los animales de capa dorada son más agresivos que los de otros colores (Podberscek y Serpell, 1996; Houpt y Willis, 2001).

Las diferencias entre individuos de una misma raza no se asocian siempre con diferencias en el color de la capa. Así, por ejemplo, también se han observado diferencias entre familias de Golden Retrievers (Knol et al., 1997). Además, en un estudio reciente también con Golden Retrievers en el que se utilizó el CBARQ (Canine Behavioral Assessment and Research Questionnaire) se encontró que la heredabilidad de la agresividad era elevada, indicando que las diferencias individuales se deben en parte a factores genéticos (Van den Berg, 2006). El CBARQ es un cuestionario que permite evaluar el comportamiento y el temperamento de los perros (Hsu y Serpell, 2003).

5.2. Sexo.

En general, los machos no castrados presentan más frecuentemente problemas de agresividad que los machos castrados y las hembras (Borchelt, 1983; Wright, 1991; Chomel y Trotignon, 1992; Lund et al., 1996; Podberscek y Serpell, 1996; Manteca, 2003; Reisner et al., 2005; Fatjó et al., 2007). Sin embargo, algunos estudios indican que son los machos castrados los que presentan más problemas de agresividad (Podberscek y Serpell, 1997a). Es posible que este resultado sea debido a que a menudo se recomienda la castración de los machos agresivos, de modo que los machos castrados suponen al final un porcentaje elevado de los animales. A diferencia de lo que ocurre en los machos, las hembras esterilizadas presentan más problemas de agresividad que las hembras enteras. Parece ser que esto se debería al efecto inhibitorio de la progesterona sobre el comportamiento agresivo (Hart y Eckstein, 1997).

5.3.Procedencia.

Algunos estudios indican que los perros de pequeño tamaño que se obtienen más frecuentemente de tiendas presentan más problemas de agresividad que los de gran tamaño (Arhant et al., 2010). De hecho, en un estudio se concluyó que los perros obtenidos de tiendas, de refugios y de la calle se encontraban sobrerrepresentados en el grupo de perros con problemas de comportamiento en comparación con los que procedían de criadores o particulares. Respecto al comportamiento agresivo, los autores observaron que los perros con agresividad por dominancia y miedo social procedían más frecuentemente de tiendas (Serpell y Jagoe, 1995). Estos resultados podrían ser debidos a que resulta muy difícil socializar adecuadamente a un cachorro que se encuentra en una tienda (Podberscek y Serpell, 1997a; Appleby et al., 2002).

5.4.Métodos de entrenamiento.

Varios estudios demuestran que los perros que han recibido un entrenamiento de obediencia presentan menos problemas de comportamiento que los que no lo han recibido (Clark y Boyer, 1993; Bennet y Rohlf, 2007). Además, también se observan diferencias en función del tipo de adiestramiento utilizado. Así, los propietarios que han empleado métodos de entrenamiento basados en el castigo suelen tener perros con problemas de comportamiento –y, en concreto, con agresividad- más frecuentemente que los propietarios que han utilizado un entrenamiento basado en los premios (Roll y Unshelm, 1997; Hiby et al., 2004; Blackwell et al., 2007; Herron et al., 2009).

5.5.Personalidad del propietario y manejo.

La falta de experiencia y de información sobre el comportamiento canino aumenta el riesgo de que los perros desarrollen problemas de comportamiento (Peachey, 1993). Por otra parte, los propietarios que sufren problemas emocionales suelen mostrar un manejo más deficiente de sus perros (O'Farrell, 1995). En un estudio realizado con

propietarios de Cocker Spaniel Inglés, se observó que los propietarios de perros agresivos eran menos estables emocionalmente, más tímidos, más indisciplinados y se mostraban generalmente más tensos que los propietarios de perros no agresivos (Podberscek y Serpell, 1997b). Finalmente, los perros pequeños suelen mostrar más problemas de agresividad que los grandes. Una posible causa es que los propietarios de perros pequeños suelen ser menos consistentes con las pautas de manejo y siguen con menor frecuencia programas de entrenamiento y actividades lúdicas (Arhant et al., 2010). Por otra parte, hay estudios que no han encontrado ninguna correlación entre la personalidad del propietario y el comportamiento agresivo de su perro (Dodman et al., 1996).

En resumen, pues, aunque hay muchos estudios que demuestran una relación entre la personalidad del propietario y el comportamiento agresivo del perro, es difícil saber si la personalidad del propietario es la causa o la consecuencia del comportamiento del perro.

6. La agresividad felina como modelo para el estudio de las diferencias individuales

A diferencia de lo que ocurre en el perro, no hay muchos estudios epidemiológicos sobre los factores de riesgo de la agresividad del gato.

6.1. Raza.

Tanto un estudio realizado en EEUU como un estudio realizado en Valencia concluyen que los Siameses son la raza que más frecuentemente presenta problemas de agresividad (Bamberger y Houpt, 2006; Palacio et al., 2007).

6.2.Sexo.

Un estudio realizado en 1997 concluyó que los machos presentaban más problemas de agresividad que las hembras (Lindell et al., 1997). Sin embargo, otros estudios acerca de gatos que no tenían acceso al exterior no encontraron diferencias entre machos y hembras, aunque las hembras esterilizadas presentaban más problemas de comportamiento que las hembras enteras (Heidenberger, 1997; Barry y Crowell-Davis, 1999).

6.3.Destete precoz.

Durante el destete las crías se independizan de sus madres y aprenden a tolerar la frustración (Neville y Bessant, 2000). Además, aprenden la secuencia de caza y a identificar a sus posibles presas; el papel de la medre es crucial en este aprendizaje (Kitchener, 1991). Un destete precoz podría alterar este proceso y aumentar el riesgo de que los cachorros muestren problemas de agresividad al llegar a la edad adulta (Heath, 2007).

6.4.Otros factores.

En general, los gatos sin acceso al exterior tienen un mayor riesgo de sufrir síndrome urológico felino, problemas de obesidad y problemas de comportamiento (incluyendo agresividad y eliminación inadecuada), que los gatos que tienen un acceso parcial o total al exterior (Mertens y Schär, 1988; Heidenberg, 1997; Buffington et al., 2002; Rochlitz, 2005; Heath, 2007).

La falta de acceso al exterior puede impedir la manifestación de conductas propias de la especie, tales como la conducta depredadora, lo que podría resultar en agresividad hacia los propietarios u otros gatos (Heath, 2007). Además, aunque el proceso de domesticación puede haber modificado en parte el comportamiento social del gato

doméstico, éste sigue mostrando una tendencia a ser territorial y poco gregario (Milani, 1987). Por ello, convivir con otros gatos en espacios reducidos puede aumentar el riesgo de agresividad y de otros problemas de comportamiento. De hecho, varios estudios indican que los problemas de comportamiento son más frecuentes en gatos que conviven con otros gatos (Rochlitz, 2005; Casey y Bradshaw, 2007).

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OBJETIVOS

1. Estudiar la epidemiología de los problemas de comportamiento del gato, incluyendo su prevalencia y los factores de riesgo relativos a la raza, sexo, estado reproductor, procedencia, acceso al exterior y número de gatos que conviven en un mismo domicilio.

2. Estudiar el estímulo desencadenante, el blanco alternativo, la postura corporal y los factores de riesgo de la agresividad redirigida del gato.

3. Estudiar la epidemiología del comportamiento agresivo de los perros de raza Cocker Spaniel Inglés, incluyendo su prevalencia y los factores de riesgo relativos al sexo, estado reproductor, procedencia y color de la capa.

4. Caracterizar el comportamiento agresivo del Cocker Spaniel Inglés para determinar si esta raza presenta una mayor frecuencia de agresividad impulsiva que otras razas de perros.

5. Determinar la concentración sérica de serotonina en perros agresivos de raza Cocker Spaniel Inglés como posible mecanismo responsable de la impulsividad en la conducta agresiva de esta raza.

CAPÍTULO 1

Potential risk factors associated with feline behaviour problems

Abstract

A retrospective study was carried out on feline behaviour problems presented at the Animal Behaviour Clinic at the Barcelona School of Veterinary Medicine to identify the main risk factors. Three hundred thirty six cats presented for a behaviour problem between 1998 and 2006 were included in the study group. A total of 189 presented at the Hospital of the Barcelona School of Veterinary Medine for problems other than behavioural and having no record of behaviour problems were used as control group. The main owner's complaint was aggression (47%) followed by inappropriate elimination (39%). 64 % of aggression cases involved conflicts between cats and 36 % of cases were aggression towards people, owners being the most common target of aggression (78% of all cases of aggression were directed towards people). Play-related aggression and petting-related aggression were the main causes of aggressive behaviour towards people (43.1 and 39.6% of cases respectively). Most housesoiling problems involved urination (59%), followed by urination and defecation (32 %) and defecation (9%), and the most common diagnosis was aversion to the litterbox (63.4%). Persian cats were presented more frequently for elimination problems than other breeds ($\chi2$ = 6.40; p<0.01). Cats with behaviour problems came from pet shops more frequently than control cats ($\chi2$ = 10.39; p<0.001). Cats without outdoor access showed significantly more behaviour problems than those with outdoor access ($\chi2$ = 31.85; p<0.001) and aggression problems were more common in single cat households than in multicat households ($\chi2$ = 25.47; p<0.001). Intact females were presented more frequently for aggression problems than neutered females ($\chi2$= 7.74; p<0.01).

Introduction

The number of cats has increased and even surpassed the number of dogs in some countries (PFMA, 2000; Kendall and Ley, 2006; APPMA, 2008). In fact, a recent study concluded that the majority of people prefer cats as pets (Casey and Bradshaw, 2008a) because they are easier to take care of than dogs and also because they appear to be

more independent (Zasloff and Kidd, 1994; Downey and Ellis, 2008). In Spain, around 13 % of all households have one or more cats , and 6.3 % of households have both dogs and cats (Veterindustria, 2006). The increase of cat numbers can partly explain why the number of cats referred for behaviour problems has increased over the last few years (Heath, 2007; Casey and Bradshaw, 2008b).

The term "behaviour problem" is used to describe any behaviour shown by an animal (in the context of this paper, a cat) that is unacceptable to the owner. Some behaviour problems such as sexual marking are normal behaviours, that is, they belong to the normal feline behaviour repertoire and yet, when shown in a domestic environment, became objectionable (Casey and Bradshaw, 2008b).

Behaviour problems are important for several reasons. First, they are one of the most common reasons for relinquishment of cats (Kass, 2007). A 2004 report concluded that half of the adopted kittens had at least one behaviour problem after the first month (Wright and Amoss, 2004) and other authors have found that behaviour problems account for more than one third of all the unsuccessful rehomings of abandoned cats (Shore, 2005).

Second, behaviour problems are important from a public health point of view because although the percentage of aggression problems is higher towards other cats than towards people, a high number of aggressive episodes are still directed towards people. Physical and psychological consequences of cat attacks should not be underestimated, mainly when the target of the attacks are elderly people, children or people with compromised immunity (August, 1995; Heath, 2002).

Finally, but not less important, behaviour problems may negatively affect the welfare of the animals, mainly when they are a consequence of stress or anxiety (Heath, 2007).

Epidemiological studies are important to understand the risk factors of behaviour problems and thus the best preventive measures. However, results can vary depending on the geographical area and the source of data. For example, previous studies have shown that data obtained through a questionnaire to the general practitioners are different from those obtained through a consultation in a referral service (Fatjó et al., 2006). To the best of our knowledge, this is the first epidemiological study on behaviour problems in cats carried out in Spain and our objectives were to (1) describe the most common behaviour problems in a feline population attended in a referral behaviour service and (2) identify the risk factors on which preventive measures should be based.

Animals, Materials and Methods

Study side

The study group came from the caseload of the Animal Behaviour Service at the Veterinary Teaching Hospital of the Universitat Autònoma de Barcelona located 20 km from Barcelona. The Veterinary teaching Hospital attends around 13.000 cases per year, primarily referred by veterinarians from the Barcelona metropolitan area.

Data Collection

Cases included in this retrospective study were presented for behaviour problems at the Animal Behaviour Service between 1998 and 2006. Data were obtained using a standard questionnaire that the owner had to fill at the time of consultation. Information obtained during the interview is summarized in Table 1. All cats included in the study underwent a thorough physical examination.

Table 1. Main areas in which questionnaire was divided

General information	Name of the cat
	Breed
	Sex and neutering status
	Age
	Age of adoption
	Source of adoption
Physical and social environment	
Social behaviour	
Nutrition	
Elimination habits	
Daily activities	
Training	
Description of behaviour problema	Beginning of the problem
	Context in which problem occurs
	Frequency and evolution
Description of the cat's general behavior	

To categorize aggressive cases, four main criteria were used: the beginning and evolution of the problem, the target of aggression, the context in which aggression occured and the cat body posture during the aggression. The classification of aggressive behaviour used in this paper is derived from that developed by other authors (Voith, 1983; Beaver, 1989a; Overall, 1997). Cases that did not fit any category were included in the group "other forms of aggression". If a cat showed more than one form of aggression, each form was considered and analyzed separately.

Control population

In order to identify risks factors, a control population was randomly selected from the general database of the same hospital during the same period of time. Control cats did not have any history of behaviour problems. Owners of control cats were interviewed

using a standard questionnaire to obtain information on signalment, physical and social environment, and other relevant characteristics of cats.

Statistical analysis

The significance of the relationship between the occurrence of behaviour problems and cat characteristics was analysed with a Chi^2–test. A value of $P < 0.05$ was considered significant for all analyses. All statistical analyses were performed using SPSS 15.0 for Windows.

For the analysis of breed predisposition, cats of the study group without a specific problem were included into the control group. Crossbreds were excluded from the analysis.

Results

A total of 336 cases presented from 1998 to 2006 were included in the study group. 178 (53%) were females (64.6% of which were castrated) and 158 (47 %) were males (77.2 % of which were castrated). The average age at evaluation was 4.5 years. 116 cats had been rescued from the street (45.8%), 74 were homebred (29.2%), 44 had been purchased from a petshop (17.4%), 14 had been obtained from animal shelter (5.5%) and 5 had been purchased from a professional breeder (1.9%). The source of 83 cats (24.7%) was unknown. 42 cats (14%) had outdoor acces, whereas 179 (59%) lived with other cats in the same household. 82 cats were pure bred cats (24%) and 254 (76%) were Domestic European Shorthair. Siamese and Persian accounted for the highest percentage of pure bred cats. The average age at which cats were adopted was 4.6 months (SD= 10.87).

Information was also collected on 189 control cats. 95 cats were males (75 of which were neutered; 78.95%) and 94 were female (68 of which were spayed; 72.34 %). The

average age at evaluation was 4.9 years. 87 cats were rescued from the street (46.52%), 58 (31.02%) were obtained from a private owner, 20 (10.70 %) were acquired from an animal shelter, 13 (6.95 %) were purchased from a petshop, and 9 (4.81 %) were obtained from a professional breeder. 121 (64.64%) cats were indoor cats and 67 (35.64%) had outdoor access.. 123 (65.78 %) cats lived with other cats in the same household. 41 cats were purebred (21.69%) and 148 (78.31%) were Domestic European Shorthair. As in the study group, Persian (60.97%) and Siamese (26.83%) accounted for the highest percentage of pure bred cats. Mean age of cats at adoption was 3.9 months (SD=32.95). Data of both groups are summarized in Table 2.

Aggression was the main owner complaints (171 diagnoses out of a total of 365; 47%), followed by inappropriate elimination (142/365; 39%), compulsive behaviour (13/365; 3.5%), excessive vocalization (10/365; 2.5%) and fear and phobias (9/365; 2.5%). Other problems such as anorexia, furniture scratching an overactivity were included in the same group (20/365; 5.4%) (Figure 1). The average number of behaviour problems per cat was 1.1.

In relation to the target of aggression, cats showed aggression more frequently towards other cats (110/171; 64%) than towards people. When the aggression was directed towards people, the most common target was the owner (46/59; 78%).

Most cases of aggression directed towards family members met the criteria of play related aggression (25/58; 43.1%) and petting related aggression (23/58; 39.6%). Almost twenty eight percent of cats showed at the same time play-related aggression and petting-related aggression. When the aggression was directed to unfamiliar people, 70% of cats showed defensive aggression (7/10), followed by offensive aggression (3/10; 30%). A similar result was found for intercat aggression and almost seventy percent showed defensive aggression (72/107; 67.3%) whereas
31.8 % (34/107) showed offensive aggression towards another cat. In one case the owner was not able to describe the cat body posture.

Figure 1. Number of cases according to the owner complain

Number of cases
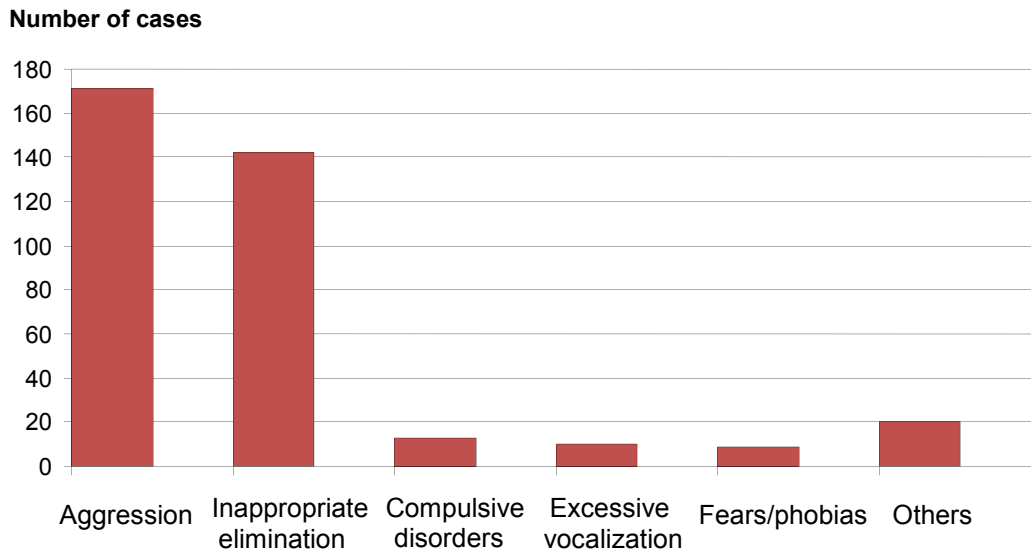
Table 2. Characteristics of cats in the study and control group

	Study group		Control group	
N	336		189	
Sex				
Females Males	178 (53 %)	158 (47 %)	94(49.74%)	95 (50.26 %)
Intact Neutered Intact Neutered	63 115 36 122		26 68 20 75	
Source				
Street	116 (45.85 %)		87 (46.52 %)	
Private owner	74 (29.25 %)		58 (31.02 %)	
Pet shop	44 (17.39 %)		13 (6.95 %)	
Animal shelter	14 (5.53 %)		20 (10.70 %)	
Professional breeder	5 (1.98 %)		9 (4.81 %)	
Mean age at evaluation (years)	4.5		4.9	
Mean age of adoption (months)	4.6		3.9	

Most of the elimination cases involved urination (84/142; 59%), followed by urination and defecation (45/142; 32%), and defecation (13/142; 9%). Although it seems to be a certain degree of overlap between some categories of diagnosis, the most frequent diagnosis was litterbox aversion (90/142; 63.4%) followed by urine marking (22/142; 15.5%; see Table 3). Persian cats showed elimination problems out the litterbox more frequently than other breeds (χ^2 = 6.40; p<0.01). No breed effect was found for any other behaviour problem.

The study population came more frequently from petshops than the control group (χ^2 = 10.39; p<0.001). The percentage of breeds did not differ between both groups.

A lower percentage of cats in the study group had outdoor access than in the control group (261/303; 86% in the study group vs. 121/188; 64.64% in the control group; χ^2 = 31.85; p<0.001). Cats from multicat households showed less aggressive problems towards family members than cats from households with only one cat (χ^2= 25.47; p<0.001).

No effect of sex or neutering status was found on the likelihood of cats' showing behaviour problems except for the fact that intact females showed aggression problems more frequenlty than neutered ones (χ^2= 7.74; p<0.01).

Discussion

According to the present study, aggression and elimination problems are the most commonly reported behaviour problems in urban Spanish cats. These results are similar to those obtained in other referral practices (Blackshaw, 1985; Borchelt, 1987; APBC, 2005; Bamberger and Houpt, 2006). For instance, according to the Association of Pet behaviour Counsellors, around 39 % of cats were referred for inappropriate elimination and 32 % for aggression problems (APBC, 2005). These data indicate that these problems are very common and also that they may be particularly challenging and

therefore poorly tolerated by many owners who will ask for advice more readily than when the cat shows another problem (Heath, 2007; Casey and Bradshaw, 2008b).

Table 3. Distribution of diagnosis. Each cat may have more than 1 diagnosis

Diagnosis	Nº of cats	(%)
Aggression	195	(49.2)
People-directed aggression	68	(17.2)
Defensive aggression towards family members	3	(0.7)
Play-related aggression	27	(6.8)
Petting-related aggression	26	(6.6)
Defensive aggression towards unfamiliar people	7	(1.8)
Offensive aggression towards unfamiliar people	3	(0.7)
Frustration related aggression	2	(0.5)
Animal-directed aggression	107	(27)
Defensive aggression towards family cat	72	(18.2)
Offensive aggression towards family cat	34	(8.6)
Defensive aggression towards dog family	1	(0.2)
Redirected aggression	20	(5)
House soiling	131	(33.1)
Inappropriate elimination related to the litter box	90	(22.7)
Marking	22	(5.5)
Others	19	(4.8)
Compulsive disorders	11	(2.8)
Psychogenic alopecia	6	(1.5)
Feline hyperesthesia	4	(1)
Wool sucking	1	(0.2)
Ingestive disorders	2	(0.5)
Obesity	1	(0.2)
Pica	1	(0.2)
Fears/Phobias	6	(1.5)
Towards other cats	3	(0.75)
Towards people	2	(0.5)
Towards sounds	1	(0.2)
Sexual behaviour	1	(0.2)
Miscellaneous	15	(3.8)
Others	35	(8.8)

Depending on the source of information, there could be some discrepancies between epidemiologic studies. A previous study done in the same geographic area through a questionnaire send to general paractitioners concluded that the most common behaviour problem was inappropriate elimination followed by furniture scratching (Fatjó et al., 2006). According to the present study, however, furniture scratching accounted for a very small number of cases. This could be due to the fact that furniture scratching is not perceived as serious enough as to seek the advice of a behaviourist (Fatjó et al, 2006).

As other authors have reported, intercat aggression appears to be more frequent than aggression towards people (Houpt, 1998; Heath, 2002; APBC, 2005; Bamberger and Houpt, 2006). In our study, the high proportion of multicat households (59%) combined with the high proportion of indoor cats (86%) could contribute to the high percentage of aggression between cats in the caseload (Heidenberg, 1997; APBC, 2005). Conflicts among cats may be more likely if the home range is small, as it occurs with indoor cats (Rochlitz, 2005). According to Leyhausen, indoor cats may show aggression as a result of dispersion being prevented. Furthermore, the lack of a developed communicative language in cats as compared with dogs, may increase the likelihood of aggressive encounters (Leyhausen, 1979). According to Bernstein and Strack, indoor cats should have access to at least two rooms and an additional space shoud be added in multicat households (Bernstein and Strack, 1996). In our study area, the proportion of indoor cats (study group 86%; control group 64.4%) was much higher than in other countries (Heidenberger, 1997; Levine et al, 2005). For instance, in UK, the majority of cats have access to the outside and less than 20% of cats were kept indoors permanently (APBC, 2005).

In the present study the percentage of indoor cats was higher in the study group than in the control group. These results suggest that behaviour problems may be associated with keeping cats indoors, as other authors have reported before (Mertens and Schär, 1988; Heidenberg 1997; Buffington, 2002). It is important to emphasize, however, that

quality of space is at least as important as the amount of space per se. Environmental enrichment in the form of vertical structures, scratching posts, and hiding places, for example, can improve the welfare of cats (Carlstead et al., 1993). Further, it is also very important to avoid either a monotonous and impoverished environment or unpredictable changes, as both could cause stress (Broom and Johnson, 1993; Rochlitz, 2005).

Aggression towards family members accounted for the majority of aggression cases towards people. According to our results and to previous studies, housing a single cat is correlated with a high likelihood of aggressive behaviour towards the owners (APBC, 2005). Cats kept without contact with other cats can direct play behaviour towards their owner more frequently that group-housed cats (Borchelt and Voith, 1987; Beaver, 2004) and play-related aggression was one of the most common causes of aggression. Indeed, it has been suggested that play-related aggression may be reduced by adding a second cat (Beaver, 2003a). The other most frequent form of aggression towards owners was petting-related aggression and a similar result has been found in other studies (Chapman, 1991). This could be due to the owners' inability to detect the subtle warning signals that precede an episode of petting-related aggression (Crowell-Davis, 1997).

Elimination problems related to the litter box, also categorized as a litterbox aversion, accounted for the great majority of housesoiling problems, as reported elsewhere (Beaver, 1989b; Halip et al., 1998; Bamberger and Houpt, 2006). Lack of appropriate management by the owners may explain the high incidence of litterbox aversion (Bamberger and Houpt, 2006).

Several studies have found a breed predisposition, with Persian and Siameses being more likely than other breeds to have elimination and aggression problems respectively (Beaver, 1989a; Beaver 1989b; Bamberger and Houpt, 2006). In the present study, Persian cats were presented more often for elimination problems than other breeds.

Beaver (2003b) suggested that Persian cats might have difficulties in learning elimination habits.

The results of the present study suggest that the origin of the cat could be a risk factor and cats purchased from petshops were presented more often for behaviour problems than those adopted from other sources. Serpell and Jagoe (1995) found that dogs with dominance-type aggression and social fear came more frequently from pet shops than control dogs but to the best of our knowledge this is the first study reporting a similar effect on cat behaviour. There are at least two possible mechanisms that could explain this finding. First, it is widely accepted that cats should be exposed to a variety of stimuli during the socialization period between 2 and 7 weeks of age (Karsh and Turner, 1998; McCune, 1995) and it is likely that many pet shops provide a relatively poor environment compared with other sources (Casey and Bradshaw, 2008a).

Secondly, early weaning may have long-lasting effects on behaviour. For example, early-weaned kittens may have difficulties to control the strength of their bite when playing (Overall, 1994a; Overall, 1994b). Further, it seems that licking by the mother has beneficial effects on the stress response and, those individuals that have been subjected to intense licking shortly after birth are better able to adjust their stress response to the intensity of the stressor compared with animals that have been subjected to less licking and these effects also persist over time, as indicated in rats (Champagne et al., 2003). In addition, previous studies conducted in laboratory animals suggested that exposure to stressors during the early postnatal period or the post-weaning juvenile phase can permanently alter the neural system and consequently some aspects of the behaviour due to changes on the epigenome (Meaney, 2001; Champagne et al., 2003; Holmes et al, 2005). Therefore, inadequate breeding management could be a source of stress with long lasting effects. Whether cats from petshops are more likely than cats from other sources to be exposed to stressors early in life warrants further investigation.

In the majority of species, males are more aggressive than females (Nelson, 2000). Nevertheless, in some species such as golden hamster (*Mesocricetus auratus*), for example, females are more aggressive than males (Nelson, 2000). Several studies have reported that female cats are presented for aggression more frequently than male cats (Wright, 1990; Palacio et al, 2007). In our study, no significant differences were found for aggression problems between males and females. Nevertheless, intact females were more aggressive than neutered females. This result is at variance with those obtained in dogs which concluded that neutering can increase aggressive behaviour in females due to the elimination of progesterone, which has a calming effect (Hart and Eckstein, 1997). In contrast, removal of progesterone seems to have the opposite effect in female golden hamsters (Payne and Swanson, 1972). One study with feral cats by Neville and Remfry (1984) concluded that neutering reduced aggressive behaviour in both sexes (Neville and Remfry, 1984), although the underlying physiological mechanisms are not known. We did not analyse the effect of neutering of females on each category of aggression. However, the possibility that entire females may be more territorial than neutered as they would need to defend a larger territory to raise offspring can not be ruled out.

Conclusion

According to the present study five risk factors were identified. Cats purchased from petshops and those without outdoor access had a higher risk of developing behaviour problems; intact females showed more frequently aggression problems than neutered females, the likelihood of aggression towards people was significantly higher in single cat households, and, Persian cats were presented for elimination problems more frequently than other breeds. The knowledge of these risk factors could help to advise owners and prevent behaviour problems.

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CAPÍTULO 2

Inciting causes, alternative targets, and risk factors associated with redirected aggression in cats

Abstract

Objective—To identify inciting causes, alternative targets, and risk factors associated with redirected aggression in cats.

Design—Case-control study.

Animals—19 cats with a history of redirected aggression and 64 cats with no such history.

Procedures—Medical records were reviewed to identify cats evaluated for problems with redirected aggression (case cats), in which the primary inciting stimulus and alternative target of aggression were clearly identifiable. Data obtained from the records and from a follow-up interview included details about the cats and incidents of redirected aggression. Owners of control cats were interviewed via telephone to obtain similar information on control cats.

Results—22 incidents of redirected aggression were reported for the 19 case cats. In 95% of those incidents, loud noises or interaction with other cats were identified as the inciting stimuli. Case cats most commonly redirected their aggression toward the owner, followed by another cat living in the same household. Case cats were more likely to have a sound phobia but were less likely to be outdoor cats than were control cats. In addition, case cats were more likely to be from small households ($\leq$ 2 people) than were control cats. In most situations, case cats reportedly adopted a defensive body posture immediately before the incident of redirected aggression, which suggested that the underlying motivation was fear.

Conclusions and Clinical Relevance—Fear was likely the most common motivation for redirected aggression in the cats of this report. To reduce the risk of redirected

aggression, veterinarians should encourage owners to socialise kittens and habituate them to novel objects and sounds.

Introduction

Redirected aggression in cats is suspected when a cat behaves aggressively toward an irrelevant but accessible target at least once, and the primary inciting stimulus is inaccessible or no longer available.[1,2] This type of aggression (also known as displaced aggression) is reportedly one of the most common forms of feline aggression toward people,[2,3] accounting for approximately 50% of 27 cats evaluated for aggression toward people in one study.[2] Because of its unpredictable and violent nature, redirected aggression is considered a dangerous forms of feline aggression.[2,4] Bites from aggressors are uninhibited and attacks are usually difficult to stop, and aggressors typically remain highly aroused long after the inciting event has passed.[2,3,5,6] This fact can make diagnosis difficult because the relationship between the aggressive episodes and the primary inciting stimuli may not be obvious.

Regardless of the common and dangerous nature of redirected aggression in cats, few researchers have investigated the subject.[2,7] In particular, as far as the authors are aware, little is known about whether cats that exhibit redirected aggression have a distinct behavioral profile. The underlying motivation of this type of aggression in cats also remains unclear. According to Moyer's classification of aggressive behavior,[8] redirected aggression is included in the category of irritable aggression, which is usually the consequence of a high state of arousal induced by frustration or pain. This classification approach corresponds with the so-called frustration-aggression hypothesis,[9] according to which frustration often leads to aggression. Frustration and subsequent aggression may originate, for example, from defeat in a competitive contest, as has been detected in baboons[10], rainbow trout[11] and laboratory cats.[8] Noxious stimuli, such as an electric shock or a loud noise, may elicit an attack against a

nearby animal or an object primarily when the escape-avoidance behavior is not possible or too difficult.[12,13]

The purpose of the study reported here was to analyze several incidents of redirected aggression, with a special emphasis on the identification of the triggering stimulus and the alternative target. Specifically, we sought to compare characteristics of cats with a history of redirected aggression with those of cats without such a history to understand the motivation behind redirected aggression and the factors that may certain cats susceptible to displaying this type of aggression.

Materials and Methods

Animals—All cats evaluated for problems with aggression from 1998 through 2006 at the Animal Behaviour Clinic of the Barcelona School of Veterinary Medicine were considered for inclusion as case cats. Control cats were randomly selected from the same period of time from the general database of the same hospital. All cats included in the study underwent a thorough physical examination.

For information on case cats, medical records were reviewed to obtain data on signalment, living conditions, age at and source of acquisition, and a detailed description of aggressive behaviors and other relevant aspects of behavior. A presumptive diagnosis of redirected aggression was established whenever a primary inciting stimulus and an alternative target were clearly identified via the clinical history. Follow-up interviews with owners of all cats with recorded incidents of redirected aggression were conducted via telephone by use of a standardized questionnaire. Clients were specifically asked about the evolution of the problem and whether more episodes of redirected aggression occurred since the time of the last visit.

Owners of control cats were interviewed via telephone by use of a standardized questionnaire to obtain information on signalment, physical and social environment, and

other general characteristics of the cats.

Statistical analysis—A $\chi 2$ test was used to investigate associations between redirected aggression and certain cat characteristics, including sex, neuter status, age at acquisition, origin (street, private owner, pet shop, animal shelter, professional breeder), history of noise phobia, access to the outdoors, and size of household ($\leq$ 2 people, >2 people). A value of P < 0.05 was considered significant for all analyses. Data were analyzed by use of statistical software.[a]

Results

Of the 336 cats evaluated at the hospital for behavioral problems, 171 (46.8%) problems of aggression were identified. The main complaint of owners was aggression toward other cats (110/171 [64.3%]), followed by aggression toward people (59/171 [34.5%]). The remaining 2 (1.2%) cats were evaluated for aggression toward the family dog. Nineteen (11.1%) cats had displayed $\geq$ 1 episode that met the aforementioned criterion for redirected aggression. One episode of redirected aggression was reported in the records of 16 cats, whereas 2 episodes were reported in the records of the remaining 3 cats, for a total of 22 episodes of redirected aggression.

Seventeen of the 19 case cats were domestic shorthair cats, 1 was a Persian cat, and 1 was a Siamese cat. Eleven cats were male (10 neutered, 1 sexually intact) and 8 were female (5 spayed, 3 sexually intact). Mean age of the cats was 3.6 years (from 1 to 11 years). Nine cats were acquired as strays, 5 (29.4%) were obtained from a private owner, and 3 were purchased from a pet store. The source of 2 cats was unknown. Mean age at acquisition was 2.5 months (from 1 week to 18 months). Seventeen cats lived indoors, and eleven of these lived with other cats in the same household.

Information was also collected on 64 control cats. Breeds included domestic shorthair cat cat (50/64 [78.1%]), Persian (7/64 [10.9%]), Siamese (5/64 [7.8%], Bengali (1/64

[1.5%]), and Carthusian (1/64 [1.5%]). Thirty-five (54.7%) cats were male (28/35 [80%] neutered; 7/35 [20%] sexually intact) and 29 (45.3%) were female (24/29 [82.7%] spayed; 5/29 [17.3%] sexually intact). Mean age of the cats was 6 years (from 6 months to 14 years). Twenty-six (40.6%) cats were obtained from a private owner, 25 (39.1%) were obtained as strays, 5 (7.8%) were purchased from a pet store, 4 (6.2%) were obtained from a professional breeder, and 4 (6.2%) were acquired from an animal shelter. Mean age of cats at acquisition was 2.75 months (from birth to 12 months). Twenty-four (37.5%) cats were indoor cats and 40 (62.5%) had access to the outdoors. None of the control cats were reported to have displayed behavior compatible with redirected aggression.

With respect to the 22 episodes of redirected aggression reported for the19 cats, the most common inciting stimuli were loud noises (11/22 [50.0%]), followed by interactions with other cats (10/22 [45.4%]) and visiting people (1/22 [4.5%]). Specific inciting auditory stimuli included loud noises from falling objects, televisions, cellular phones, and an electric drill. Eight episodes of redirected aggression triggered by loud noises occurred in cats with a concomitant noise phobia; 5 of those 8 cats displayed a clearly defensive body posture before, during, and soon after the attacks. Half (n = 5) of the 10 episodes of redirected aggression triggered by other cats involved 2 cats living in the same household. Redirected aggression occurred during a fight or after high-pitch vocalization from one of the cats.

Owners were able to remember elements of the body posture of the cats in 18 of 22 (81.8%) episodes. When recalling 14 (77.8%) of these episodes, owners described a defensive body posture, including an arched lateral display, flattened ears, an inverted U-shaped tail, piloerection, hissing, and a high-pitch meow. Physical characteristics of cats during the other 4 (22.2%) episodes of redirected aggression were characterized as direct eye contact, constricted pupils, a straight-forward view, and tail lashing.

The most commonly reported alternative target was the owner (14/22 [58.3%]), followed by another cat living in the same household (7/22 [29.2%]), an unfamiliar person (2/22 [8.3%]), and the family dog (1/22 [4.2%]). In 2 aggressive episodes, there were 2 targets: the owner and another cat living in the same household. When only multicat households were considered, aggression appeared to be equally directed toward people and other cats. Nevertheless, this later finding could not be stadistically tested due to the reduced number of cases.

Twelve of 19 owners were contacted for long-term follow-up at least 6 months after the last behavioral consultation on record. Eight of 12 cats were reported to have displayed episodes of redirected aggression after the consultation and 2 of these had been euthanized for that reason. The remaining 4 cats reportedly did not display redirected aggression again.

Statistical analyses revealed 3 factors differed between cats with redirected aggression and control cats. Cats with redirected aggression were significantly ($\chi2 = 8.49$; $P = 0.004$) more likely to have a sound phobia (64.7%) than were control cats (23/64 [35.9%]). Control cats were significantly ($\chi2 = 5.96$; $P = 0.015$) more likely to be outdoor cats than were cats that displayed redirected aggression. In addition, cats living with 1 or 2 owners were significantly ($\chi2 = 6.53$; $P = 0.011$) more likely to exhibit redirected aggression than those living with 3 or more owners. Case and control cats were not significantly different with respect to distributions of other factors such as sex, neuter status, age at acquisition and origin.

Discussion

Aggression was the most common behavior problem reported by cat owners in the study reported here. This finding agrees with results of other studies[5,14,15] that indicate aggression and housesoiling are the most common behavioral problems in cats evaluated at referral practices. The most common alternative target of aggression in our

study was other cats, which has also been reported by other investigators. [2,3,15] A survey14 performed in the United Kingdom revealed that 23% of cats evaluated for behavior problems in 2005 had reportedly displayed intercat aggression, while 13% had displayed aggression toward people. Another study[16] conducted in the United States revealed that 25.1% of cats evaluated at an animal behavior clinic had displayed intercat aggression and 13.6% had displayed aggression toward people.

The proportion of cats that had displayed redirected aggression in our study (11%) was lower than that reported for another study (33%).[2] Investigators in that study determined that approximately 50% of all diagnoses of people-directed aggression in cats met the criteria for redirected aggression. This apparent disagreement between results may be explained by the different methodologies used in both studies. First, researchers in the other study[2] did not require that a primary inciting stimulus be specifically identified when classifying cats as having displayed redirected aggression; we did. In fact, in that other study, 33% of all cats in which feline aggression was diagnosed were considered to have displayed definite redirected aggression, whereas 9% of cats were reported as having displayed probable redirected aggression. Second, in the other study,[2] only cats that displayed people-directed aggression were included in the denominator when calculating proportions of cats with redirected aggression, whereas in our study, all cats evaluated for feline aggression were included. When the same approach used in the other study is applied to our data, the proportion of cats with redirected aggression increases to 27%.

Although redirected aggression could be secondary to other diagnoses such as fear or territorial aggression, this form of aggression is included in most classifications of feline aggression as an independent diagnostic category.[17] The lack of consensus regarding the terminology used to categorize behavior problems remains a matter of discussion.[18]

A basic medical assessment for cats evaluated for aggression should include a physical examination and laboratory tests, including a CBC, serum biochemical

analysis, and urinalysis. Nevertheless, in our study some diagnostic tests had to be postponed to avoid stressing the cats as well as to prevent new episodes of aggression when cats had to be handled by their owners and the veterinarian. Similar difficulties in conducting complete medical examinations in behavioral medicine have been described in many clinical reports.[7,19–21]

Our findings regarding inciting stimuli for redirected aggression in cats correspond with a previous study [2]: loud noises and other cats are the most common causes. According to the frustration-aggression hypothesis,[9] when an inciting stimulus cannot be the target of aggression (eg, a loud noise), the aggressive reaction is redirected toward an alternative target, whereas when the inciting stimulus can be targeted, aggression may still be redirected because of the existence of a physical or social barrier.

In the present study, cats in families of 1 or 2 people had a higher incidence of redirected aggression than did families with the control group of cats. Although we do not have a clear explanation for this, perhaps the socialization of cats with people was better in households with > 2 people. It is well known that an inappropriate socialization is one of the main reasons of fear-aggressive behaviour.[3,4,22] In addition, our results indicated that indoor cats were more likely to display redirected aggression than were outdoor cats. It may be that indoor cats have fewer opportunities to escape when threatened and are less habituated to loud noises. Moreover, indoor cats may be more likely to be near other alternative targets.

Some behaviorists distinguish between displaced aggression and triggered displaced aggression with respect to alternative targets. Displaced aggression refers to a situation in which a primary stimulus induces a high state of negative arousal that is subsequently redirected to a neutral stimulus. In triggered displaced aggression, the secondary target is perceived as a provocative stimulus on its own. Thus, redirected aggression results from the effect of the alternative target on a previously aroused subject.[23] In some cases of redirected aggression included in the present study, review

of the clinical history revealed a prior conflict between the alternative target and the cat, whereas in others, the alternative target had an otherwise neutral and even friendly social relationship with the aggressor. A similarity between the triggering stimulus and alternative target has been suggested.[9,24] In other words, when the triggering event is a cat, the alternative target will also be a cat. Our results do not support that hypothesis because people were the most common target in our study. It could be argued that not all cats in our study lived with other cats. However, even when only multicat households were considered, aggression seemed to be equally directed toward people and other cats. This could suggest that the alternative target is a matter of chance.

Behavior problems in cats can become chronic, depending on the tolerance of the owner. That tolerance is influenced by previous experience, cultural background, and expectations regarding acceptable behaviour.[25] According to the results of our study, with the exception of 2 cats, owners reported just 1 episode of redirected aggression prior occuring to the consultation. This finding supports the idea that redirected aggression is an intense, unpredictable, and dangerous form of aggression that impels the owner to quickly seek help.

The function (if any) of redirected aggression in cats is still unclear. Redirected aggression may serve as a coping mechanism when cats are exposed to stressful events. In support of that hypothesis are studies that have revealed that acts of redirected aggression reportedly decrease plasma glucocorticoid concentrations in rats, baboons, and fish.[11,26,27] Two findings from our study may give additional support to this. First, in most situations of redirected aggression, owners reported that their cats displayed a clearly defensive posture, suggesting the underlying motivation was fear, which is linked to stress.[28–30] Second, cats that displayed redirected aggression were more likely to have noise phobias than were control cats, which suggests that they perceived noises as more stressful. However, additional studies are needed to obtain a better understanding of the physiologic and functional bases of redirected aggression. On the basis of the findings of our study, we recommend that veterinarians encourage

owners to socialise their kittens via interaction with unfamiliar people and other cats and to habituate kittens to various sounds and novel objects.

Footnotes

[a]. All data was analyzed using the SPSS 15.0 for Windows, SPSS Inc., Chicago.

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CAPÍTULO 3

Animal Behaviour Case of the Month

Statement of the Problem

Two cats were evaluated because of aggression towards each other and their owners.

Signalment

The cats were a 2-year-old 7-kg (15.4-lb) castrated male domestic shorthair (cat 1) and a 2-year-old 4-kg (8.8-lb) castrated male domestic shorthair (cat 2).

History

The current owners of the 2 cats had adopted them at 8 weeks from different households. The owners consisted of a young couple living in a small apartment. The cats were kept indoors all the time.

Prior to the onset of the present problem, the relationship between the cats had been good, as inferred from the presence of allogrooming, allorubbing, mutual play, and a common resting location. No signs of aggression had been observed prior to the onset of the present problem.

Three episodes of aggression were initially reported by the owners. The first took place when a relative came into the house with her own cat. Cat 1 attacked the visiting cat as soon as it came out of its cage. According to the owner, cat 1 adopted a defensive posture, including an arched lateral display, flattened ears, an inverted U-shaped tail, piloerection, hissing, and a high pitch meow. The visiting cat tried to escape, showing also a defensive posture without any clear signals of aggression. The owners managed to interrupt the fight, and the visiting cat was immediately removed from the household.

The second episode took place an hour after first, when the relative came back to the house, this time without her cat. At this time, cat 1 suddenly attacked cat 2, adopting an

attitude similar to that described for the first episode. Cat 2 responded with defensive aggression, including signals such as an arched tail, piloerection, flattened ears, pupilary dilation, and hissing. The owners again managed to separate the cats and placed them in different locations within the apartment.

After 2 days, the owners tried to reintroduce the cats to each other. Initially, although no clear signs of aggression were observed, the owners described a high state of arousal and vigilant attitude in both cats. After 2 days, a loud medium- to high-frequency sound from the television triggered an aggressive reaction from cat 2 toward cat 1. The husband tried to separate the cats, and cat 2 severely attacked the wife, who was standing in the same room, but at some distance from the husband and cat 1. The cats were again separated within the apartment. After 2 weeks, cat 2 still showed clear signs of defensive aggression whenever approached by the owners, who decided to seek professional help.

Physical Examination Findings and Laboratory Results

No specific medical tests were performed at the time of the behavioral consultation. Results of a complete physical examination performed 2 months earlier prior to routine vaccination had been unremarkable.

The behavioral examination revealed that cat 2 had always reacted with aggression toward the owners in 2 different contexts. After being petted for a while, the cat showed an inhibited bite and ran away. Also, the cat hid from time to time in various locations and attacked its owners' legs and ankles as they were passing by.

Diagnosis

A diagnosis of feline aggression can be made on the basis of 3 basic diagnostic criteria: target of the attacks, context in which the aggression occurs, and communicative signals during episodes of aggression.[1] The 3 episodes of aggression initially reported by the owners could be explained in terms of 2 categories of aggression: fear-related aggression and redirected agression.[1] Regarding the first episode, territorial aggression was ruled out on the basis of the cat's posture, which was clearly defensive.

Fear-related aggression is displayed toward a social stimulus that is perceived to be a threat by the cat, whether the stimulus is indeed threatening or not. Typically the problem has an acute onset, and sometimes develops in response to a single aversive event.[1,2] Redirected aggression is considered one of the most common types of aggression in cats and can be observed in any situation during which an attack is prevented or the primary target is not available.[1-3] The resultant state of aggressive arousal lasts for some time and can be easily directed to a substitute target. The most common triggering stimuli for redirected aggression are the sight, sound, or odor of an unfamiliar person or cat. Also, the occurrence of loud and high-pitched sounds has been described as a possible eliciting stimulus for redirected aggression in cats.[1-3] The differential diagnosis for redirected aggression includes pain-related aggression and organic conditions such as neurologic problems (eg, meningioma) and hormonal disorders (eg, hyperthyroidism).[4,5]

To rule out medical conditions, a thorough medical examination should be performed in all cats referred because of aggression.[5] In the present case, medical tests were postponed to avoid stressing the cats as well as to prevent new episodes of aggression that could occur if the cats had been handled by their owners or the veterinarian. All forms of aggression described by the owners of these 2 cats met well-established criteria for diagnostic categories in behavioral medicine and episodes of aggression could be clearly linked to environmental cues. Difficulties in performing a complete

medical examination in patients referred for behavioral problems have been described previously.[6-8]

Although not the owners' primary complaint, the behavioral history revealed that cat 2 displayed play-related aggression and petting-related aggression. Play-related aggression is one of the more common types of aggression towards people. Attacks are usually observed when the owner passes by the cat or in response to sudden hand or leg movements.[5,9] Petting-related aggression, also called irritable aggression, is recognized by an increasing number of authors as a common form of aggression toward owners. After a period of tolerance to being petted, some cats suddenly bite the owner and jump down.[9]

Treatment and Follow-up

The unpredictable and uninhibited nature of the attacks make redirected aggression one of the most dangerous forms of feline aggression toward people.[10] Redirected attacks often cause multiple and severe wounds and can be particularly hazardous for children, disabled people, and persons suffering from immunosuppressive or vascular diseases.[10]

Any treatment plan for cats with aggression problems must deal first with human safety. Risk factors for feline aggression include those related to the cat's behavior and those related to its social environment. Uninhibited and unpredictable attacks are particularly dangerous, especially when children are present. Consequently, in some cases, euthanasia may be the only reasonable recommendation.[11,12] Nevertheless, it is important for the attending veterinarian to analyze all possible treatment options and discuss risk factors with the owner. In the end, owners should make their decision on the basis of their level of comfort with the risk of other aggressive episodes occurring.

According to the owners' initial description, cat 2 showed a very unpredictable form of human-directed aggression. However, as a result of the behavioral history, triggering stimuli could be identified and avoided. This finding, together with the family composition, allowed the initiation of a treatment protocol that included behavior modification and use of feline synthetic pheromones.

The proposed treatment plan could be divided in 2 parts. First, recommendations were made to prevent redirected aggression and to reestablish social tolerance between the cats. Second, measures were taken to address play-related and petting-related aggression.

The owners were instructed to avoid or diminish the presence of potential arousing stimuli, such as visiting cats and loud, high-pitched sounds. Also, information about how to recognize signals of arousal and aggression, such us a stiff body posture, piloerection, tail twitching, and dilated pupils,[13] was provided. Whenever aggression was suspected, the owners were advised to carefully isolate the cat in a dark room and avoid any kind of physical interaction until some behavior incompatible with aggression, such as eating, grooming, or resting, was observed.[1,3]

A type of counterconditioning known as systematic desensitization was used to change the cats' perception of each other as a threatening stimulus. The procedure involved exposing the 2 cats to increasing levels of interaction. First, cats were separated in 2 areas and had neither physical nor visual contact. Olfactory habituation was allowed by interchanging the cat's territories from time to time and also by alternatively rubbing each cat with the same towel. After 2 weeks, when no signs of distress were observed, cats were allowed to have visual contact through a mesh door. To encourage close proximity between the cats in a positive context, highly palatable food was placed on both sides of the door. After 2 more weeks, when no indicators of anxiety were observed, the owners were instructed to remove the mesh door for progressively longer periods. Initially, whenever the door was opened, food bowls with preferred foods were

placed at a distance far enough to avoid any aggression or distress response in either cat. Provided that both cats showed a relaxed attitude, food bowls were moved closer and closer until physical contact was possible. At the beginning of this stage, cats were separated as soon as food was consumed. Eventually, the time the cats were allowed to stay close to each other after eating the food was progressively increased until separation was no longer required. It was emphasized to the owners that the duration of each stage of the systematic desensitization program would depend on the progress shown by each cat, and thus could differ from one stage to another.

In addition to the behavior modification program, a synthetic pheromone diffusera was used to reduce the level of anxiety of the cats. Synthetic feline facial pheromones have proven to be effective in a variety of situations where a stress reaction is likely to be present, such as in some forms of urinary marking, hospitalization, and transportation.[14-16] Regarding play-related aggression, owners were encouraged to play more with cat 2 with interactive toys that move and stimulate chasing, stalking, pouncing, grabbing, and swatting behaviors.[17]

To prevent further episodes of petting-related aggression, physical contact was only allowed when the cat actively sought attention. Once initiated, all interactions had to be of short duration to prevent an aggressive response.

After 1 year of treatment, no more episodes of aggression toward people or between the cats were reported. Regarding the relationship between the cats, affiliative behaviors, such as allogrooming and allorubing, were progressively regained through the first 6 weeks of treatment. Interestingly, cat 1 showed an increased level of arousal any time someone came into the house after having been in contact with other cats. In such situations, the owners were always able to calm the cat by diverting its attention with play or food. As additional preventive measures, the owners were advised to avoid as much as possible loud and high-pitched sounds and to remind the cat-owning

relative to wash her hands and change her clothes whenever she came back to the house.

Comments

Redirected aggression is a common behavior problem that can be diagnosed only after performing a thorough behavioral examination. In the cats described in the present report, the momentary introduction of another cat was the primary cause of aggression, which induced a long-lasting social conflict between the resident cats and a problem of aggression towards the owners in one cat. In addition to redirected aggression, play-related aggression and petting-related aggression were identified. Multiple diagnoses of aggression are common in behavioral medicine,[5] and each of them must be assessed independently. Once all forms of aggression have been characterized, a comprehensive treatment protocol can be designed. In this case, treatment encompassed 3 main strategies: removing or avoiding the triggering stimuli, teaching the owners to anticipate the attacks, and addressing the consequences attacks had on the social relationships between the cats and with the owners.[3] Also, additional measures were taken to correct the problems of play-related and petting-related aggression.

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CAPÍTULO 4

Aggressive Behavior in the English Cocker Spaniel

Abstract

A high percentage of aggression problems and a tendency to display noninhibited aggression in the English cocker spaniel (ECS) have been suggested by many authors. The authors of this paper designed a retrospective study to analyze the aggressive behavior of 145 ECSs presented for aggression problems to the Animal Behavior Service at the Barcelona School of Veterinary Medicine's veterinary teaching hospital. Aggressive ECSs were compared with a population of dogs of the same breed presented for a behavior problem other than aggression and with a population of aggressive dogs of other breeds. The most common forms of aggression in the ECS were owner-directed aggression (67.6%), aggression toward unfamiliar people (18.4%), aggression toward unfamiliar dogs (10.1%), and aggression toward family dogs (3.3%).Owner-directed aggression was more common in the ECS than in other breeds, although in similar contexts. In the ECS, the golden coat color was more common in the aggressive dogs than in nonaggressive dogs. ECSs showed impulsive aggression more frequently than aggressive dogs of other breeds. The aim of the study was to analyze cases of aggressive ECSs seen in a referral practice.

Introduction

The study of canine aggression is important for several reasons. First, it has a large impact on human public health, not only because of the derived economic costs, but also due to the physical and psychological injuries arising from dog bites (Sosin et al., 1992; Mertens, 2002). Second, behavior problems are one of the main reasons for euthanasia and relinquishment of dogs to animal shelters (Patronek et al., 1995; Houpt et al., 1996) and aggression problems are one of the most common owner complaints in veterinary general practice and also in behavior referral practices (Overall, 1997a; Fatjó et al., 2006). Finally, aggression problems could affect the animal's well-being since there is evidence that aggressive behavior may involve a stress response (Menno et al.,

2004). The study of the mechanisms that control the appearance of aggression and the identification of the risk factors related to aggression are essential to establish effective preventive measures.

Breed related risk factors can result from genetic predispositions to environmental influences, including early environment and training methods (Mertens, 2002).

Scott and Fuller were among the first authors that used an experimental design to show differences in behavior traits between different breeds. Among different breeds included in their experimental study, Fox terriers were the most aggressive, followed by Basenjis and Shetland sheep dogs, and finally by American cockers and Beagles (Scott and Fuller, 1965). More recently, a survey of veterinarians and kennel club judges suggested breed differences in behavior for 13 behavioral traits, many of them related to aggression. In this study, the English Cocker Spaniel (ECS) was included in the group of breeds with moderate aggression and high reactivity (Hart and Hart, 1985). Several epidemiologic studies support that some breeds such as the ECS are more prone to display certain forms of aggression than others (Lund et al., 1996; Overall, 1997b; Bradshaw and Goodwin, 1998; Svartberg, 2006; Takeuchi and Mori, 2006).

The temperament of the ECS has been previously assessed through a questionnaire to owners (Podberscek and Serpell, 1996). A first analysis yielded general data on aggressive ECS, including contexts in which aggression occurred. According to these results, solid color ECSs were significantly more likely to show aggression than particolors and males were significantly more likely to show aggression than females in the majority of the 13 situations included in the study (Podberscek and Serpell, 1996). Using information from the aforementioned study, dogs were divided into two groups of high and low aggression profiles which were related to the personality of their owners. Solid colors and neutered dogs were more commonly found in the high aggression group. Dogs in the high aggression group reacted more slowly to commands and were more reactive to loud noises (Podberscek and Serpell, 1997a). Regarding personality

traits, owners of dogs included in the high aggression group were more likely to be tense, emotionally less stable, shy and undisciplined (Podberscek and Serpell, 1997b).

Clinical reports from many small animal behaviorists suggest that owner directed aggression is frequently observed in ECSs (Landsberg, 1991; Beaver, 1994; Pageat, 1998). Further, ECSs may have a characteristic way of expressing this form of aggression, attacks being frequently described as impulsive and occurring in the absence of a clear triggering event according to the owner's description. The term impulsiveness has been described as a lack of warning signals previous to an attack (Peremans et al., 2003). According to some authors, this could be a particular form of competitive aggression (Neville, 1991; Reisner, 1996; Pageat, 1998) while others suggest the existence of an underlying organic problem (Beaver, 1980; Colter, 1989; Dodman et al., 1992).

Nevertheless, to the best of the authors' knowledge there are no published quantitative data on the characteristics of clinical cases of aggression in the ECS seen by small animal veterinary behaviorists. The aim of our study was to analyze aggressive cases of ECS attended in a referral practice to better understand the underlying factors that could influence the expression of this behavior.

Material and methods

In order to characterize their behavior, one hundred forty five ECS presented for aggression at the Animal Behavior Services at the Barcelona School of Veterinary Medicine between 1998 and 2006 were studied. The clinical history obtained through an standard questionnaire to the owner provided general information, such as neutering status, age of adoption, source from which the dog was obtained, coat color and a detailed description of the aggressive episodes and other relevant aspects of the dog's behavior.

The study group was compared with a population of ECS presented for a behavior problem other than aggression (n=28) as well as with a group of dogs from other breeds with aggressive problems (n=499). Both samples of dogs were obtained from the database of the Animal Behavior Services (Universitat Autònoma de Barcelona). Crossbreds were excluded from the analysis. All dogs were considered healthy based on physical examination, serum biochemistry and complete blood count. All comparisons were done through chi-square tests using the SPSS 15.0 for Windows.

To calculate risk factors for owner-directed aggression in this population, the number of cockers in the general population was obtained from REIAC (Spanish Network for the Identification of Companion Animals).

Results

In the aggressive ECS group (n=145), forty two ECS (29%) were females (95.2% of which were intact) and one hundred three (71.0 %) were males (92.2 % of which were intact) (Table 1). The average age at which cockers were adopted was 5.6 months. Sixty of them (45.6 %) had been purchased from a pet shop, thirty seven (28.3 %) from a private owner, twenty five (21 %) from professional breeders, five (3.6 %) had been rescued from the street and two (1.4 %) had been adopted from an animal shelter. In relation to coat color, 88 ECS were golden (60.7 %), 32 were black (22.1 %), 24 were bicolor (16.5 %) and one was tricolor (0.7 %). Mean age at the moment of consultation was 3.6 years.

With regard to the population of the nonaggressive cockers (n=28), 10 were males (9 intact, 1 neutered) and 18 were females (15 intact, 3 neutered). Mean age of adoption was 3.5 months. Six of them (30 %) had been purchased from a pet shop, nine (45 %) from a private owner, four (20 %) from professional breeders and one (5 %) had been rescued from the street. Information about the origin of the dog in 8 animals was

unknown. In relation to the coat color, 11 ECS were golden (42.3 %), 6 were black (23.1 %) and 9 were bicolor (34.6 %). Mean age at the moment of consultation was 2.7 years.

Table 1. Study groups

Parameter	Aggressive Cockers	Nonaggressive cockers	Aggressive non-ECS population
N	145	28	499
Sex			
Females	42 (28.97%)	18 (64.28%)	145 (29.06%)
Intact	40	15	131
Neutered	2	3	14
Males	103 (71.03%)	10 (35.71%)	354 (70.94%)
Intact	95	9	327
Neutered	8	1	27
Source			
Pet shops	60 (45.65%)	6 (30%)	89 (24.18%)
Private owner	37 (28.26%)	9 (45%)	132 (35.87%)
Breeder	25 (21.01%)	4 (20%)	126 (34.24%)
Street	5 (3.62%)	1 (5%)	13 (3.53%)
Animal shelter	2 (1.45%)	0	8 (2.17%)
Coat color			
Golden	88 (60.69%)	11 (42.31%)	
Black	32 (22.07%)	6 (23.08%)	
Bicolor	24 (16.55%)	9 (34.62%)	
Tricolor	1 (0.69%)	0	
Mean age at adoption (mo)	5.6	3.5	4.6
Mean age at consultation (y)	3.6	2.7	3.2

Concerning the aggressive non- ECS population (n=499), 354 dogs were males (327 intact, 27 neutered) and 145 were females (131 intact, 14 neutered). Mean age of adoption was 4.6 months. Of all cases where the origin was known (n=368), eighty nine dogs (24.2 %) had been purchased from a pet shop, one hundred thirty two (35.9 %) from a private owner, one hundred twenty six (34.2%) from professional breeder, thirteen (3.5%) had been rescued from the street and eight dogs (2.2 %) had been adopted from an animal shelter. Mean age at the moment of consultation was 3.2 years.

Fifteen percent of purebred dogs presented for behavior problems were ECS. The main reason for consultation was aggression (n= 145; 84%).

Owner-directed aggression was the most commonly reported problem in both populations of aggressive dogs. When both groups were compared, aggression towards the owners was observed more frequently in ECS than in the other breeds (67.6% vs. 36.5%; X^2=54.54; p<0.001). Conversely, aggressive non- ECS population showed aggression problems towards unfamiliar people (26.4% vs 18.4%; X^2=4.76; p<0.02), family dogs (14.8% vs. 3.3%; X^2=17.06; p<0.001) and unfamiliar dogs (21.6% vs. 10.1%; X^2=12.06; p<0.002) more frequently than aggressive ECS (Table 2 and Fig.1). Taking into account that 3.52 % of purebred dogs of REIAC (Spanish Network for Dog Identification) were ECS, the risk factor for owner-directed aggression in our population was 10.32.

Aggressive ECS came more frequently from pet shops than aggressive non ECS population (45.6% vs 24.2%; X^2 = 20.7; p< 0.01). No differences were observed between aggressive and non-aggressive ECS.

Males were more frequently found in the group of aggressive ECS (71% vs 29%; X^2 = 12.92; p< 0.001) and also in the aggressive non-ECS population (71% vs 29.1%; X^2 = 24.75; p< 0.001) than females. There were no differences in the percentage of neutered animals among the three groups of dogs.

The golden coat was significantly more common in the group of aggressive ECS than in the group of non-aggressive ECS (60.7% vs 42.3%; X^2 = 5.03; p<0.03). No differences were found between the two populations of ECS for the other two coat colors (Fig.2).

Fig.1. Owners' complaints. Aggressive ECS population was significantly more likely to show owner directed aggression than aggressive non-ECS population whereas aggressive non-ECS group was significantly more likely to show aggression problems toward unfamiliar people, family dogs, and unfamiliar dogs than aggressive ECS.
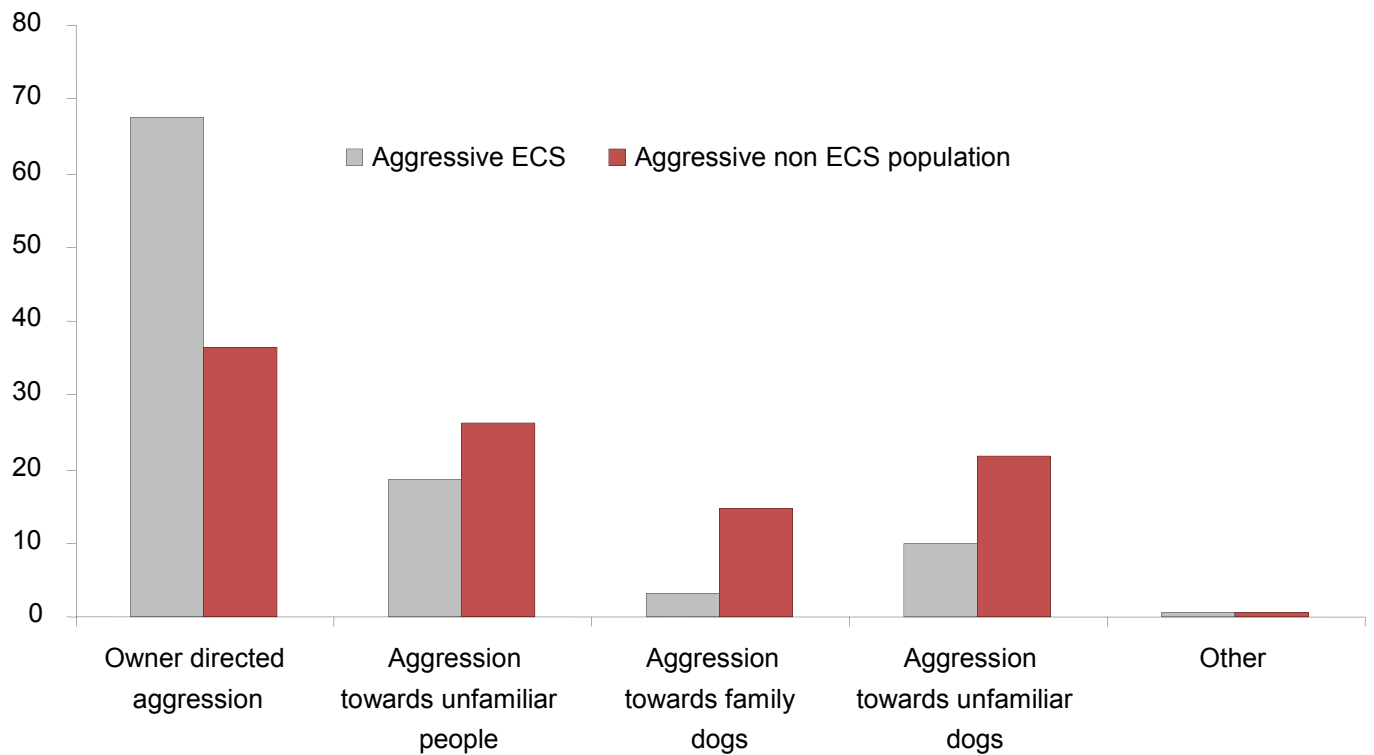
Table 2. Aggression problems according to the owner's complaint. Each dog could show more than one aggression problem.

Owner Complaint	Aggressive cockers n (%)	Aggressive non-ECS population n (%)
Owner-directed aggression	121 (67.60%)	221 (36.47%)
Aggression towards unfamiliar people	33 (18.44%)	160 (26.40%)
Aggression towards family dog	6 (3.35%)	90 (14.85%)
Aggression towards unfamiliar dogs	18 (10.06%)	131 (21.62%)
Other	1 (0.56%)	4 (0.66%)

Fig. 2. Distribution of coat colors for the two populations of cockers. In the ECS population, Golden/red color was more common in the aggressive group than in non aggressive group.
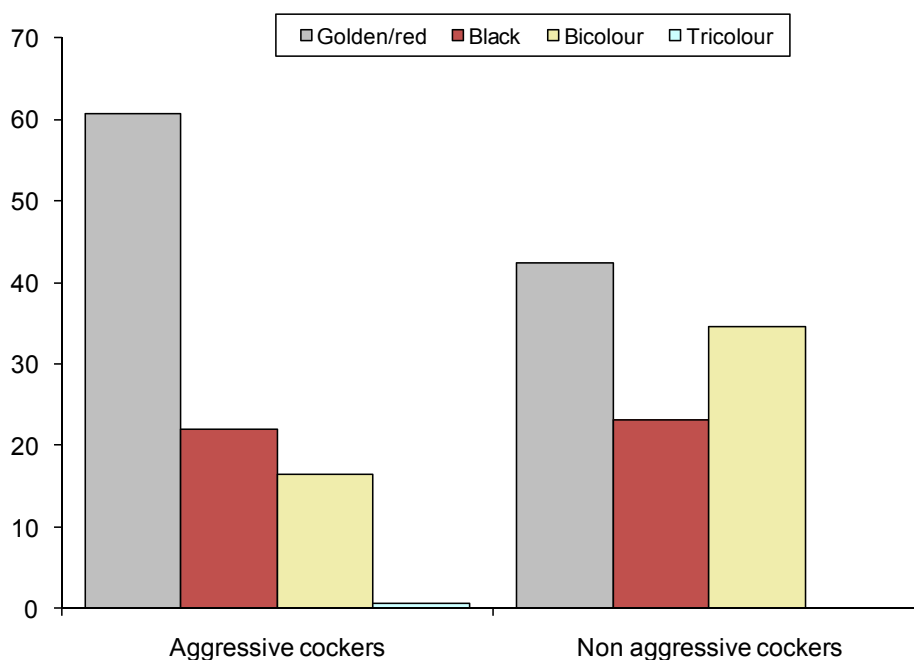
In the group of ECS displaying owner-directed aggression (n=121; 67.6%), 82% did so in a context involving food or object guarding, 67.4% when disturbed while resting, 61.4% when handled, 63.6% when punished and 36% while being petted. No significant differences were detected between aggressive ECS and aggressive dogs of other breeds in the context in which aggression was displayed. On average each dog displayed aggression in 3 contexts. No statistical associations were found between contexts.

The body language of ECS showing owner-directed aggression could be analyzed in the 98 cases where the owner was able to report that information. Fifty-six percent (n=55) of owners reported 1 or more ambivalent signals during aggressive episodes. We considered an ambivalence posture when the owner described the presence at the same time of offensive and defensive signs (Beaver, 1999). In forty four percent (n=43) of cases the dog's body posture was considered mainly offensive, since no elements of ambivalence were noticeable to the owner. These results were not significantly different from those observed in other breeds.

According to the owner's description of the sequence of the attack, three groups of dogs were identified. Dogs that always reacted with impulsiveness (6%), those that never showed impulsiveness (57%) and those were both forms of aggression were reported (37%). Comparing both groups of aggressive dogs, ECS were found to show impulsive attacks more frequently than aggressive dogs of other breeds (43.7% vs 30.9%; X^2=4.92; p<0.03). No relationship was found between coat color and impulsivity or between sex and impulsivity.

Discussion

ECS were found to have a higher percentage of owner directed aggression and a higher rate of impulsiveness than aggressive non-ECS population.

A high proportion of a particular breed in the caseload of a referral service could result from a combination of three different factors: first, a higher presence of that breed in the overall canine population; a difference in the owner reaction to a problem depending on the breed of the dog, and genuine breed differences, including genetic and environmental factors that play a role in the expression of aggressive behavior, particularly towards family members.

The percentage of 1 particular breed should be corrected within relations to its presence in the overall canine population. Further, the proportion of dogs of one breed may change over time both in the referral database and in the general population (Bamberger and Houpt, 2006). According to the REIAC (Spanish Network for Dog Identification) the proportion of ECSs in the overall canine population in our geographic area has not substantially changed over the last four years. Therefore, according to this data, the high proportion of aggressive ECS found in the present study does not seem to be a consequence of a higher popularity of this breed in the general population.

The owner's perception of an aggression problem may be influenced by the dog's breed and the way aggression is expressed. Some owners may be particularly sensitive and reactive to a problem that has been popularly linked to ECSs, as it has been also suggested for aggression in the ECS in the USA (Overall, 1997b). Moreover, living with an aggressive dog, especially if it shows impulsiveness towards family members, may be particularly challenging and therefore poorly tolerated by many owners (Lund et al., 1996; Fatjó et al., 2007). In fact, impulsive aggression is one of the main risk factors for euthanasia of aggressive dogs (Reisner et al., 1994).

The study of genetic factors involved in the neurophysiology of aggression could help to understand breed differences in the expression of aggressive behavior. Differences in some genes involved on behavior may explain why some breeds are more prone to show aggression than others. Recent studies suggest the existence of polymorphisms

between different breeds in genes involved in the control of neurotransmitters like dopamine and glutamate (Niimi et al., 1999; Ogata et al., 2006; Takeuchi et al., 2005).

Also, differences in the level of aggression have been identified within the same breed. For instance, differences have been reported in the aggressive behavior of ECS depending on coat color (Podberscek and Serpell, 1996; Pérez-Guisado et al., 2006). In fact, coat color is one of the physical traits more commonly associated to genetic influences in aggressive behavior in the ECSs (Houpt and Willis, 2001). According to our data, the golden coat was observed more frequently in the aggressive than in the control group of ECSs. This finding is in accordance with previous data from a survey of ECSs owners in the UK (Podberscek and Serpell, 1996). Breed differences in aggressive behavior linked to coat color have been also described in other breeds. A study comparing the population of Labrador retrievers presented either for aggression or for medical problems to a veterinary teaching hospital concluded that the percentage of yellow Labrador retrievers was significantly higher in the aggressive group. Chocolate and black Labradors were seen at comparable rates in both populations of dogs (Houpt and Willis, 2001).

Several mechanisms have been proposed to explain the link between coat color and temperament traits. Melanin shares a common biochemical synthesis pathway with dopamine and other neurotransmitters involved in the control of aggressive behavior (Hemmer, 1990). Alternatively, the association could be due to the existence of pleiotropic genes involved in the expression of both traits. Finally, some studies suggest the existence of genetic linkage, where two genes controlling different traits are very close to each other and therefore may be inherited together (Keeler, 1942; Belyaev et al., 1981; Cottle and Price, 1987; Hayssen, 1997).

Besides genetic factors, environmental aspects such as handling and owner personality seem to play an important role in the development of aggressive behavior (Dodman et al., 1996). A survey of owners of ECS concluded that owners of dogs showing a high

aggression profile were more likely to be tense, emotionally less stable, shy and undisciplined than owners of less aggressive dogs. Besides the possible influence of the owner's personality on the behavior of the dog, these results could be alternatively understood in terms of the effects of an aggression problem on the family members. Further, this correlation could reflect a link between some personality traits of the owners and their preference to adopt a particular breed (Podberseck and Serpell, 1997b).

A previous study also found a link between the experience of the owner and the prevalence of dominance-related aggression. The authors suggested that dogs belonging to first-time owners showed dominance-related aggression more frequently than dogs belonging to experienced owners, probably owing less capable handling and a lack of knowledge of canine communication (Jagoe and Serpell, 1996). A more detailed analysis of the personality traits and handling methods of the owners may help to understand aggressive behavior in the ECS.

Regarding sex and neutering status, males were more frequently found in the group of aggressive ECS than females. Nevertheless, this finding does not reflect a breed specific characteristic, since it is not significantly different from what was observed in aggressive non-ECS population. In fact, there is a large evidence of the influence of male sexual hormones in the expression of offensive aggression in a variety of species, including the dog (Wright, 1991; Lund et al., 1996; Manteca, 2003; Reisner et al., 2005).

Previous studies on canine aggression found a percentage of dogs showing unpredictable attacks that may be an indication of a lack of impulse control ranging from 8% to 76% (Podberscek and Serpell, 1996; Reisner et al., 1996). The estimated prevalence of impulsive aggression depends on whether we consider dogs always showing aggression without warning signals or dogs where impulsive attacks coexist with signaled forms of aggression. The percentage of dogs always reacting in an impulsive way in the present study (6%) is very close to that described by other authors

(8%) (Podberscek and Serpell, 1996). Alternatively, if dogs showing signaled as well as non-signaled attacks are considered, the rate of impulsive aggression increases up to 42%.

Compared with aggressive dogs of other breeds, ECSs showed impulsive attacks more frequently. There are several possibilities to explain this non inhibited way to display aggression by ECS. Morphological changes due to domestication could make difficult to distinguish some expressions of threat in some breeds (Fox, 1971; Goodwin et al., 1997). For instance, in the ECS the drooping ears and short tail may make it more difficult to understand the dog's body language (Beaver, 1999). Therefore, aggressive episodes in these dogs may be incorrectly perceived by the owner as being impulsive. Moreover, a recent study of the owner's ability to read and remember the dog's body language suggest that people fail to report correctly common signals of aggression (Correia et al., 2007).

According to some authors, impulsive aggression may be the result of the selective reinforcement of the biting phase within the aggressive sequence. Through this learning process dogs may learn to suppress warning signals, since they are not useful in deterring the opponent (Pageat, 1998).

From a neurophysiological perspective, aggression –and particularly impulsive aggression- has been linked to a central serotonergic dysfunction in humans, laboratory animals and domestic dogs (Mehlman et al., 1994; Reisner et al., 1996; Kavoussi et al., 1997; Peremans et al., 2003; Van der Vegt et al., 2003). Reisner et al. (1996) observed a correlation between cerebrospinal fluid monoamine metabolites and aggression towards the owner in dogs. They found lower levels of 5HTIAA in aggressive dogs, particularly in those not displaying warning signals prior to an attack. More recently a study using single-photon emission tomography indicated differences in the activity of serotonin receptors in the brain of dogs showing impulsive attacks (Peremans et al., 2003).

Conclusions

According to our results, the ECS were presented to a referral practice more frequently for aggression than dogs of other breeds. Also, the aggression of ECS was different from that of other breeds, with a higher rate of impulsive attacks in the ECS. The present study provides some quantitative data on the effect of breed differences on the occurrence of behavior problems, which could help to develop more effective preventive and treatment strategies.

Acknowledgements

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CAPÍTULO 5

Differences in serotonin levels between Aggressive English Cocker Spaniel and Aggressive dogs of other breeds

Abstract

Aggression is one of the most common behavioral problems in dogs and may have important negative effects on public health, human-animal bond and animal welfare. There is ample evidence showing a negative correlation between serotonin serum levels and aggressive behavior in a variety of species, including the domestic dogs. This negative correlation is particularly pronounced in dogs that show impulsive aggression. Data obtained in previous studies suggests that the English Cocker Spaniel (ECS) is more likely to show impulsive aggression than other breeds. Therefore, the aim of this study was to analyze possible differences in serum serotonin levels between aggressive ECS and aggressive dogs of other breeds.

Nineteen ECS dogs presented for aggression at the Animal Behavior Service were evaluated. The study group was compared with twenty aggressive dogs of other breeds attended in the same centre. Serum serotonin levels were measured using an ELISA method. Statistical analysis was done using the SPSS 15.0 for Windows.

Aggressive ECSs had significantly lower levels of serum serotonin than aggressive dogs of other breeds (318.6 ng/ml ± 67.1 and 852.77 ng/ml±100.58 respectively). Variances were not significantly different between ECSs and other breeds (SD= 449.84 vs 292.47; p>0.05).

Our results indicate that ECSs have lower serotonin activity than aggressive dogs of other breeds and this could explain why ECSs seem to be more likely to show impulsive aggression than other breeds. ECS could be a good model to study the neurophysiologic mechanisms underlying impulsive aggression.

Introduction

Dog aggressive behavior has important negative effects on the welfare of dogs and on public health (Goldstein, 1992; Sacks et al., 1996; Palacio et al., 2005; De Keuster et al., 2006). For instance, in the United States, the treatment of the physical and psychological effects of dogs bites costs between 30 and 100 million US dollars each year (Berzon et al., 1972; Matter & Arbeitsgemeinschaft, 1998; Weiss et al., 1998; Borud et al., 2000). In fact, bite accidents s are the main threat that domestic dogs pose to human health. On the other hand, behavior problems are one of the main reasons for euthanasia and relinquishment of healthy dogs to animal shelters (Reisner et al., 1994; Edney, 1998; Salman et al., 1998). In addition, as stress is often involved in aggression, most aggression problems have a negative effect on the welfare of (Moberg, 2000; Kruk et al., 2004; Stafford, 2007).

Aggressive behavior can be divided into affective (offensive and defensive aggression) and non affective aggression (predatory aggression). Affective aggression is associated to a marked autonomic activation and involves neurotransmitters such as serotonin, dopamine, noradrenalin, acetylcholine and GABA (Dodman & Shuster, 1994), whereas non affective aggression in controlled by acetylcholine mainly and does not involve autonomic activation (Beaver, 2006). In addition, the posture of the dog, the brain areas that control the aggressive response and the function of aggression are all different between the two types of aggression (Moyer, 1968).

There is strong evidence that breeds differ in their behavior (Takeuchi & Houpt, 2004; Scott & Fuller, 1965; Hart, 1995; Svartberg, 2006; Duffy et al., 2008). For example, Scott and Fuller (1965) found significant differences in all behavior traits under study between five breeds that were raised in the same environment. Lately, Hart and Hart compared the behavior of 56 breeds based on expert opinion and concluded that breeds differ in all behavior traits, although the breed effect was more pronounced for some traits than for others (Hart & Hart, 1985). With respect to aggressive behavior,

there are many studies that suggest that some breeds are more prone to show aggression problems than others (Overall, 1997; Sacks et al., 2000; Guy et al., 2001; Fatjó et al., 2007). For instance, ECS are presented to the Animal Behavior Service of the School of Veterinary Science in Barcelona (Spain) due to aggressive behavior more frequently than any other breed and more frequently than expected according to their relative abundance in the population (Fatjó et al., 2007). Other authors have obtained similar results (Lund et al., 1996; Overall, 1997; Bradshaw & Goodwin, 1998; Svartberg, 2006; Takeuchi & Mori, 2006).

There are several studies showing that low levels of serotonin are associated to aggressiveness (Brown et al., 1979; Mehlman et al., 1995; Revision Berman & Coccaro, 1998; Miczek & Fish, 2006). For example, in one study dogs with dominant type aggression had lower levels of the main metabolite of serotonin in the nervous central system than non aggressive dogs (Reisner et al., 1996). Similarly, a group of dogs with owner directed aggression had lower levels of serum serotonin than a control group without aggression problems (Rosado et al., 2010). In addition, treatment with drugs that increase the serotonin levels reduces aggressive behavior (Coccaro et al., 1990; Fava et al., 1996; Ferris et al., 1999; León et al., 2006), and diets with low levels of tryptophan, which is the precursor of serotonin, cause an increase in aggressive behavior (Young, 1991).

The aim of this study was to ascertain whether the differences in aggressive behavior between ECSs and other breeds could be related to lower level of serotonin.

Material and methods

Nineteen ECS dogs attended for aggression at the Animal Behavior Service of the School of Veterinary Science in Barcelona (Spain) were compared with twenty aggressive dogs of other breeds presented at the same centre. All dogs were considered healthy based on physical examination, serum biochemistry, T4 and TSH,

and complete blood count. Dogs included in the study were not under pharmacological treatment. A 5 ml blood sample was collected from the jugular vein of each dog into anti-coagulant-free tubes. Samples were centrifuged at 4500 x g for 15 min. Serum was frozen and stored at -80ºC until its analysis. Serotonin Elisa kid was used to measure serotonin in serum (DLD Diagnostika GMBH, Hamburg, Germany).

A T-test was used to assess the association between experimental groups and serotonin levels. A value of P < 0.05 was considered significant for all analyses. Data were analyzed by using of statistical software for Windows (version 15.0, SPSS Inc., Chicago, December 18, 2006).

Results

In the ECS group there were seven males (85.71 % of which were intact) and twelve females (50% of which were intact).The average age was 9.5 years.

In the non-ECS group, thirteen dogs were males (84.61 % of which were intact) and seven were females (all were intact). In this group we included 11 purebred dogs and 9 crossbred dogs. Breeds included in this group are detailed in table 1. The average age of the non-ECS dogs was 5 years.

The serum serotonin levels appear in table 1. The mean serum serotonin of the ECSs was 318.6 ng/ml (standard error = 67.1). The mean serum serotonin of the non-ECS was 852.77 ng/ml (standard error= 100.58). Therefore aggressive ECSs had significantly lower levels of serum serotonin than aggressive dogs of other breeds (p<0.05). The standard deviation in the ECS group and in the non-ECS group were 292.47 and 449.84 respectively and variances were not significantly different between both groups (p>0.05).

Table 1. Dogs included in the study with their serotonin concentration; M:male, F:female

Dog	Group	Breed	Sex	Neutered status	Serotonin (ng/ml)
1	Treatment	ECS	M	Intact	641.14
2	Treatment	ECS	M	Intact	906.16
3	Treatment	ECS	F	Neutered	118.85
4	Treatment	ECS	F	Neutered	34.91
5	Treatment	ECS	F	Intact	259.94
6	Treatment	ECS	F	Neutered	52.2
7	Treatment	ECS	F	Intact	164.87
8	Treatment	ECS	F	Neutered	64.01
9	Treatment	ECS	F	Intact	191.8
10	Treatment	ECS	F	Intact	455.34
11	Treatment	ECS	M	Neutered	147.85
12	Treatment	ECS	M	Intact	191.8
13	Treatment	ECS	F	Intact	818.42
14	Treatment	ECS	F	Intact	117.93
15	Treatment	ECS	M	Intact	811.03
16	Treatment	ECS	F	Neutered	104.2
17	Treatment	ECS	F	Neutered	51.5
18	Treatment	ECS	M	Intact	324.92
19	Treatment	ECS	M	Intact	596.61

Dog	Group	Breed	Sex	Neutered status	Serotonin (ng/ml)
1	Control	Labrador	F	Intact	663.14
2	Control	Crossbred	M	Intact	348.89
3	Control	Jack russell	M	Intact	1051.71
4	Control	Crossbred	F	Intact	515.98
5	Control	Crossbred	M	Neutered	1311.13
6	Control	Boxer	F	Intact	1228.34
7	Control	Crossbred	F	Intact	282.19
8	Control	Labrador	M	Intact	692.04
9	Control	Bouvier	M	Intact	692.04
10	Control	Crossbred	M	Neutered	282.19
11	Control	Beagle	F	Intact	1091.35
12	Control	Argentine Mastiff	M	Intact	1080.33
13	Control	Crossbred	F	Intact	1106.3
14	Control	Crossbred	M	Intact	1840.4
15	Control	Bull terrier	M	Intact	843.73
16	Control	Golden retriever	M	Intact	1232.74
17	Control	Pit bull terrier	M	Intact	1345.54
18	Control	Crossbred	M	Intact	43.17
19	Control	Catalan sheepdog	M	Intact	938.27
20	Control	Crossbred	F	Intact	466.03

Discussion

Dog behavior is a complex trait influenced by genetic, epigenetic and environmental factors (Brain, 2000; Nelson, 2006). It has been suggested that aggressive behavior in humans could be related to polymorphisms in genes involved in the transport, synthesis, release or metabolism of serotonin (Courtet et al., 2001; Sukonick et al., 2001). For instance, a polymorphism in one of the most important enzyme in the metabolism of serotonin (monoamine oxidase A) is associated with abnormal impulsive

behavior including aggression (Brunner et al., 1993). In laboratory animals the absence of 5HT1B receptor, one of the main receptor involved in aggression behavior, is linked to impulsiveness (Bouwknecht et al., 2001). In dogs, recent studies have identified polymorphisms that could explain behavioral differences between breeds (Niimi et al., 1999; Takeuchi et al., 2005), although so far the polymorphisms studied are not related to serotonin, but to other neurotransmitters such as dopamine (Niimi et al., 1999). The possibility exists, however, that putative differences in serotonin levels between breeds as shown in our study are caused by genetic factors.

Epigenetic factors may also be involved in neurophysiological differences within a given species. For instance, several studies in laboratory rodents have found that the tactile stimulation provided by the mother during the first few days after birth caused by maternal licking causes an increase in glucocorticoid receptors in the hippocampus (Liu et al., 1997; Weaver et al., 2004) and in serotonin levels in the nervous central system due to epigenetic effects (Meaney, 2000; Matthews et al., 2001). Therefore, different mothering styles within a given species could cause differences in serotonin levels in the offspring. Although further research is needed to see whether dog breeds in general and ECSs in particular differ in their maternal behavior, breed differences in the expression of maternal behavior has been observed in other species (Dwyer & Lawrence, 1998).

Breed differences could also be due to the fact that dogs of the same breed share a similar environment, including owner personality, husbandry or training. In fact, some authors have observed some resemblance in the owner personality of aggressive ECSs (Peachey, 1993; Podberscek & Serpell, 1997). Additionally, some handling aspects might have an important influence over dog behavior. For example, dog training methods based on punishment increase aggression problems (Roll & Unshelm, 1997; Hiby et al., 2004; Blackwell et al., 2007; Herron et al., 2009). Also, owners of smaller dogs are more inconsistent than owners of larger dogs (Arhant et al., 2010). Since the stress response is influenced by the predictability and controllability of events (Weiss,

1970; Beerda et al., 1998; Schalke et al., 2007) and there is a clear link between stress and aggression (Kruk et al., 2004), inconsistent handling could be related to increased aggressive behavior (Arhant et al., 2008). Therefore, it would be helpful to investigate whether the owners of ECSs are more inconsistent and use punishment training methods more frequently that the owners of other breeds.

Possible differences between ECSs and other breeds in the amount of physical exercise and in their diet could also explain differences in serotonin level, although studies on this particular issue are lacking. In fact, in laboratory rodents and humans, physical exercise increases serotonin levels (Chaouloff, 1997) and low levels of exercise are correlated with aggressive behavior (Jagoe & Serpell, 1996; Tsatsoulis & Fountoulakis, 2006). Preliminary findings suggest that aggressive dogs exercise less than non aggressive dogs (Mariotti et al., 2009). Low protein and high carbohydrate diets increase the amount of tryptophan that enters the brain and consequently the synthesis of serotonin (Benton, 2002). Further studies looking at the possible differences in physical exercise and diet between breeds could be useful.

ECSs are obtained more frequently from pet shops that dogs of other breeds (Amat et al., 2009), perhaps due to the popularity of this breed (Serpell & Jagoe, 1995). Dogs obtained from pet shops have more behavioral problems than dogs from other sources, probably due to the early weaning and an stressful environment in the pet shop (Serpell & Jagoe, 1995).

A previous study found that ECSs show impulsiveness more frequently than other purebred dogs (Amat et al., 2009) and impulsive aggression is one of the main risk factors for euthanasia of aggressive dogs (Reisner et al., 1994). Low levels of serotonin are correlated with impulsive aggression (Soubrié, 1986; Coccaro, 1989; Virkkunen & Linnoila, 1993; Mehlman et al., 1994; Higley et al., 1996; Kavoussi et al., 1997; Peremans et al., 2003; van der Verg et al., 2003). Violent, impulsive humans have lower levels of 5-HIAA (5-hidroxitriptamina, the main serotonin metabolite) in cerebrospinal

fluid than violent individuals that had committed a crime with premeditation (Virkkunen et al., 1995). In dogs, impulsive individuals had lower levels of 5-HIAA in cerebrospinal fluid than non impulsive ones (Reisner et al., 1996), and there is a lower activity of serotonin receptors in some areas of brain in impulsive dogs compared with non-impulsive dogs (Peremans et al., 2003).

Finally, it can not be ruled out an age effect as in our study the average age of the ECS group and the non-ECS group were different. In humans, the levels of serotonin increase during development in children and decline before puberty (Chugani et al., 2001), and there is an inverse correlation between serotonin levels and age (Seifert et al., 2004). Therefore it would be useful to analyze if the serotonin levels of ECSs change during their development.

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DISCUSIÓN GENERAL

Número medio de problemas de comportamiento por animal

Según nuestros resultados, el número medio de problemas de comportamiento por gato es de 1.1. Estos resultados son similares a los de otros estudios. Por ejemplo un estudio realizado en Inglaterra encontró una media de 1.5 problemas por animal (APBC, 2005) y en otro estudio hecho en Alemania la media fue de 2.2 problemas por gato (Heidenberger, 1997).

En el caso del perro, los resultados de otros estudios son más variables: 1.2 problemas por animal en un estudio hecho en Dinamarca (Damkjer et al., 1996), 2 problemas por animal en Inglaterra (APBC, 2005) y 4.7 problemas por animal en EEUU (Campbell, 1986). Esta variabilidad podría ser debida al hecho de que en algunos estudios se consideran sólo las quejas iniciales de los propietarios, mientras que otros autores tienen en cuenta todos los problemas que se ponen de manifiesto durante la visita, independientemente o no de que inicialmente constituyeran un motivo de preocupación para el propietario. En nuestro trabajo, consideramos las quejas iniciales del propietario

Agresividad (gato)

Según nuestros resultados, el problema más frecuente en el gato es la agresividad. Otros trabajos realizados en centros de referencia han obtenido la misma conclusión (Beaver, 1989a; Borchelt y Voith, 1996; APBC, 2005; Bamberger y Houpt, 2006). Por otra parte, los datos procedentes de veterinarios generalistas indican que los problemas de comportamiento más frecuentes del gato son los problemas de eliminación y el rascado (Fatjó et al., 2006). Esta diferencia puede ser debida a que los veterinarios generalistas refieren los casos de agresividad en mayor medida que otros problemas supuestamente menos graves.

En nuestro estudio, la agresividad entre gatos es más frecuente que la agresividad dirigida hacia las personas y supone el 64% de los problemas de agresividad. Este dato

coincide con la mayoría de estudios publicados (Borchelt y Voith, 1987; APBC, 2005; Houpt, 2005; Bamberger y Houpt, 2006). En un 68% de los casos, la agresividad entre gatos fue de tipo defensivo, mientras que en el 32% restante fue de tipo ofensivo. Es posible que el elevado porcentaje de problemas de agresividad entre gatos sea debido a que el gato doméstico, a diferencia del perro, no dispone de señales de sumisión que pueden contribuir a evitar un episodio de agresividad severa en situaciones de conflicto. Esta diferencia entre el perro y el gato puede ser consecuencia de que el lobo, que es el antepasado salvaje del perro (Olsen, 1985; Vilà et al., 1997) es un animal gregario y dispone de un lenguaje corporal muy desarrollado (Hart, 1978). Por el contrario, el gato salvaje africano, que es el antepasado del gato doméstico (Robinson, 1984; Wayne et al., 1989) es un animal habitualmente solitario (Liberg et al., 2000). Aunque el gato doméstico puede formar colonias en algunas situaciones (Crowell-Davis et al., 2004), esta conducta no se ha observado nunca en su antepasado salvaje y podría ser un resultado del proceso de domesticación. En este caso, el gato doméstico no habría desarrollado todavía pautas de comportamiento social que permitieran evitar o resolver los conflictos entre individuos. El hecho de que en el perro doméstico y en el lobo se hayan descrito conductas de reconciliación después de un episodio de agresividad mientras que dichas conductas no se han descrito en el gato (van den Bos y de Cock Buning, 1994; van den Bos, 1998) apoya esta hipótesis. Por otra parte, sin embargo, no puede descartarse la posibilidad de que la agresividad entre gatos resulte menos tolerable para los propietarios que algunas formas de agresividad dirigidas hacia las personas, en especial la agresividad por juego (ver más adelante).

En los casos de agresividad hacia las personas (36% del total de casos de agresividad), el gato mostró agresividad hacia sus propietarios en el 78% de los casos y las formas más frecuentes de agresividad fueron la agresividad por juego (43.1%) y la agresividad por falta de tolerancia a la manipulación (39.6 %). Estos resultados son interesantes por dos motivos. Por un lado, indican que algunos comportamientos normales (como el juego, por ejemplo) pueden ser molestos para el propietario; este hecho demuestra que el concepto de "problema de comportamiento" no es sinónimo de

"patología del comportamiento". Por otra parte, nuestros resultados indican que una parte importante de los problemas de comportamiento son consecuencia de un manejo inadecuado del animal, que es a su vez el resultado de una falta de información de los propietarios.

Los gatos que mostraron agresividad hacia personas desconocidas tuvieron en el 70% de los casos una motivación defensiva, es decir, su conducta agresiva fue consecuencia de una respuesta de miedo. Este resultado coincide con el de un estudio realizado en Alemania con 550 propietarios de gatos y en que se observó que uno de los estímulos que causaba más miedo a los gatos eran, precisamente, las personas desconocidas (Heidenberger, 1997).

Eliminación inadecuada (gato)

Los problemas de eliminación inadecuada aparecen cuando el gato deja de utilizar parcial o totalmente la bandeja. Estos problemas son muy frecuentes (Voith, 1984; Blackshaw, 1985; Borchelt y Voith, 1986; Beaver, 1989b; Heidenberger, 1997; Bamberger y Houpt, 2006); según nuestra base de datos, el 39 % de los gatos presentó un problema de eliminación inadecuada. En algunos estudios el porcentaje es incluso más alto (Olm y Houpt, 1988; Houpt et al., 1996; Denenberg et al., 2005). En la mayoría de los casos se trata de un problema de micción inadecuada, seguido de un problema de micción y defecación y finalmente de un problema únicamente de defecación (Olm y Houpt, 1988; Beaver, 1989; Bamberger y Houpt, 2006; Amat et al., 2009a).

Los problemas relacionados con la utilización incorrecta de la bandeja son más frecuentes que los problemas de marcaje. Por ejemplo, según nuestros datos, el 63.4% de los casos de eliminación inadecuada eran compatibles con un problema relacionado con la bandeja (sustrato inadecuado, limpieza inadecuada, localización inadecuada, etc) mientras que un 15.5% de los casos la causa más probable era una conducta de marcaje. Aunque los porcentajes pueden ser ligeramente distintos, en la mayoría de

estudios los resultados coinciden (Houpt et al., 1996; Overall, 1997a; Bamberger y Houpt, 2006). Al igual que hemos mencionado en el caso del comportamiento agresivo, la falta de información de los propietarios contribuye al desarrollo de una buena parte de los problemas de comportamiento del gato. Así, por ejemplo, muchos propietarios desconocen que a los gatos no les gusta tener la bandeja cerca de la comida o del lugar de descanso, que son muy escrupulosos con la limpieza de la arena y que prefieren la arena no perfumada (Crowell-Davis, 1986; Borchelt, 1991; Houpt et al., 1996; Neilson, 2009). Sin embargo, debemos ser cautelosos al interpretar los resultados, puesto que algunos posibles casos de marcaje sobre superficies horizontales podrían ser diagnosticados erróneamente como problemas relacionados con la bandeja (Beaver, 2003a). Otro aspecto a tener en cuenta es que muchos problemas de marcaje se resuelven con la castración (Hart y Barrett, 1973), de modo que en la mayoría de los casos no llegan a los centros de referencia.

Procedencia del animal (gato)

Según nuestros datos, los gatos que han sido adquiridos en tiendas presentan más frecuentemente problemas de comportamiento que los gatos procedentes de otros lugares (particular, criador, calle, refugio). En la especie canina también se ha observado un efecto de la procedencia, de modo que los perros con agresividad por dominancia y miedo social procedían más frecuentemente de tiendas (Serpell y Jagoe, 1995) que de otros lugares. Este hecho podría deberse a que las condiciones de alojamiento en la mayoría de las tiendas no son óptimas y, además, el tiempo que el animal pasa en la tienda coincide con el período de socialización (Serpell y Jagoe, 1995). El período de socialización del gato empieza aproximadamente a las 2 semanas de edad, coincidiendo con una cierta madurez sensorial que permite que el animal interaccione con su entorno. El final del período de socialización tiene lugar a las 9 semanas de edad aproximadamente, coincidiendo con la aparición de una respuesta de miedo frente a estímulos desconocidos (Scott y Fuller, 1965). El período de socialización es un ejemplo de período sensible, es decir, de una fase del desarrollo en

la que el entorno tiene un efecto especialmente marcado y duradero sobre el comportamiento posterior del animal (Bateson, 1979). Aunque el temperamento de un animal se debe en buena medida a factores genéticos (Cottle y Price, 1987; Hemsworth et al., 1993), el ambiente en que se mantiene al animal durante el período sensible es muy importante. En efecto, si durante este período el animal no tiene contacto con determinados estímulos, la probabilidad de que muetre miedo o agresividad hacia dichos estímulos en fases posteriores del desarrollo es muy alta (Hemsworth y Barnett, 1992; Lyons, 1992; Hemsworth et al., 1993; McCune et al., 1995; Beaver, 2003b; Pierantoni y Verga, 2007; Arai y Ohta, 2009).

Según nuestros datos, el 86% de los gatos con problemas de comportamiento no tenían acceso al exterior, frente a un 64.64% de los gatos del grupo control. Así pues, tener acceso al exterior parece reducir el riesgo de problemas de comportamiento. Otros estudios sugieren un resultado parecido e indican además que el acceso al exterior también reduce el riesgo de algunos problemas médicos (Buffington, 2002; Rochlitz, 2005)., Es posible que la falta de acceso al exterior resulte en una estimulación insuficiente del gato e impida la expresión de conductas que muestran una alta motivación, tales como la conducta exploratoria, la caza o el marcaje territorial (Wemelsfelder, 1991; Rochlitz, 2005).

También se ha observado una relación entre el número de gatos y el tipo más frecuente de problema de comportamiento. Por ejemplo, según nuestros datos, en viviendas donde solo hay un gato los problemas de agresividad hacia los miembros de la familia son más frecuentes que en las viviendas donde conviven varios gatos. En cambio, en las casas donde conviven varios gatos, los problemas de marcaje con orina y la agresividad entre gatos son más comunes; estos resultados coinciden con los de otros estudios (APBC, 2005). Una posible explicación es que en las viviendas con un solo gato el grado de interacción con los propietarios es mucho mayor y, por lo tanto, el riesgo de que aparezcan problemas de agresividad hacia las personas por juego o por

intolerancia a la manipulación es mayor (recordemos que estas dos formas de agresividad son las más frecuentes).

Raza (gato)

Algunos autores han sugerido que las razas de gatos que son muy endogámicas (tales como el Abisinio o el Siamés, por ejemplo) tienen más problemas de comportamiento que las otras (Bryant, 1944; Suehsdorf, 1964). De hecho, en estudios más recientes se ha observado una mayor presencia de siameses en la población de gatos con problemas de comportamiento que en la población de gatos control (Bamberger y Houpt, 2006). Además, varios autores han observado una mayor presencia de esta raza en el grupo de animales con problemas de agresividad y relacionados con la conducta de alimentación (Beaver, 1989a; Bradshaw y Neville, 1997; Houpt, 2005; Bamberger y Houpt, 2006). Por otra parte, los gatos de raza Persa tienen más problemas de micción y defecación inadecuada que los gatos de otras razas (Beaver, 1989b; Houpt et al., 1998; Bamberger y Houpt, 2006). De hecho, según nuestros datos, los persas presentan una mayor predisposición a padecer problemas de eliminación. Se ha sugerido que esta diferencia podría ser debida a que los gatos de raza persa tienen más dificultad para aprender la conducta de eliminación que los gatos de otras razas (Brunner, 1968). Sin embargo, a diferencia de lo que ocurre en el perro, en el caso del gato no sabemos por qué una determinada raza presenta más frecuentemente un problema de comportamiento u otro.

Sexo y estado reproductor (gato)

En algunos estudios no se observaron diferencias entre machos y hembras en relación a la prevalencia o incidencia de problemas de conducta (Barry y Crowell-Davis, 1999). En otros trabajos, por el contrario, sí que se observaron diferencias significativas, aunque muy variables. Así, por ejemplo, en un estudio los machos mostraron más problemas de comportamiento que las hembras (Bamberger y Houpt, 2006), mientras

que en otro estudio los animales que mostraron más problemas de comportamiento fueron las hembras castradas (Heidenberger, 1997). En este último estudio, sin embargo, no se utilizó ninguna población control, de modo que este resultado podría ser debido simplemente a un mayor porcentaje de hembras esterilizadas en la población general; en efecto, la castración es un procedimiento muy habitual en el gato (Bamberger y Houpt, 2006).

En el caso concreto de la agresividad, los diferentes estudios realizados hasta ahora arrojan también resultados muy variables. En la mayoría de mamíferos, incluyendo el gato doméstico, los machos se consideran más agresivos que las hembras (Nelson, 2000; Bamberger y Houpt, 2006). Sin embargo, en nuestro estudio no se encontraron diferencias entre machos y hembras en relación a la conducta agresiva. Es importante tener en cuenta que las diferencias entre sexos en relación a la conducta agresiva se limitan habitualmente a la agresividad ofensiva (Borchelt, 1983; Overall, 1997b; Simon y Lu, 2006). Según nuestros resultados, la agresividad ofensiva supone un porcentaje pequeño de los casos de agresividad del gato, lo que podría explicar el hecho de que no hayamos encontrado diferencias significativas entre machos y hembras.

A diferencia de lo que ocurre en el perro (O'Farrell y Peachey, 1990), en nuestro estudio las gatas enteras presentaron más frecuentemente problemas de agresividad que las hembras esterilizadas. Esto podría ser debido a que la castración aumenta las conductas afiliativas y reduce los comportamientos agresivos (Neville y Remfry, 1984; Crowell-Davis et al., 1997). Por otra parte, el hecho de que la castración aumente el riesgo de que las perras muestren comportamiento agresivo se debe probablemente a que la progesterona inhibe la agresividad jerárquica, que es relativamente frecuente en la especie canina (Beaver, 2009). Esta forma de agresividad, por el contrario, no ocurre o es muy poco habitual en el gato, por lo que el hecho de extirpar los ovarios y eliminar por lo tanto la fuente de progesterona no debería tener ningún efecto sobre la agresividad en las gatas.

Agresividad redirigida (gato)

La agresividad redirigida, también denominada agresividad desplazada ("displaced agresión") (Marcus-Newhall et al., 2000; Overli et al., 2004), supuso el 11% de los 171 casos de agresividad del gato registrados en nuestra base de datos. La agresividad se considera redirigida cuando el ataque se dirige hacia un blanco que no es el detonante de la motivación agresiva (Bastock et al., 1953; Chapman y Voith, 1990). En la especie felina solo hay otro estudio de agresividad redirigida con el que comparar nuestros resultados (Chapman y Voith, 1990). Según sus autores, la incidencia de este problema es mayor que en nuestro estudio y supone el 33% de todos los casos de agresividad. Sin embargo, los criterios de inclusión son ligeramente distintos, ya que los autores incluyeron casos en los que el detonante no se había identificado. Además, el porcentaje del 33% se calculó sobre los casos de agresividad que afectaron a las personas, mientras que en nuestro estudio el porcentaje del 11% se calculó sobre el total de casos de agresividad.

La agresividad redirigida es potencialmente muy peligrosa (Chapman y Voith, 1990; Landsberg et al., 2003). Por lo tanto, la eutanasia del animal es una opción que no puede descartarse, sobre todo si el gato convive con niños, ancianos o personas enfermas o discapacitadas (Askew, 1996; Borchelt y Voith, 1996; Houpt, 2005).

Nuestros resultados y los obtenidos por Borchelt y Voith (1990) indican que los estímulos que más frecuentemente desencadenan un episodio de agresividad redirigida son los ruidos fuertes y el contacto visual, olfativo o auditivo con otros gatos (en nuestro estudio estos estímulos desencadenaron el 96 % del total de episodios de agresividad redirigida). Según la hipótesis más aceptada para explicar la agresividad redirigida, cuando el estímulo detonante es inaccesible para el gato (como en el caso de un sonido intenso, por ejemplo, por ejemplo) éste redirige su agresividad hacia un blanco alternativo. Incluso cuando el detonante es accesible, el animal puede redirigir su ataque debido a la existencia de una barrera física o social (Miller, 1941).

En la mayoría de las ocasiones, los gatos adoptan una postura defensiva (78%) lo que indica que la motivación del gato es miedo. Además, la mayoría de gatos de nuestro estudio tenían miedo a los sonidos muy intensos. Ambos hechos apoyarían la hipótesis de que la agresividad redirigida es una estrategia para hacer frente al estrés (Levine et al., 1989; Virgen y Sapolsky, 1997). En roedores, por ejemplo, se ha observado que aquellos individuos que pueden mostrar comportamiento agresivo hacia otro animal después de un evento estresante presentan concentraciones plasmáticas de glucocorticoides que los animales que no pudieron mostrar comportamiento agresivo (; Levine et al. 1989; Dantzer, 1993). En primates se han obtenido resultados parecidos: los animales que tras perder una pelea con otro individuo atacaban a un tercer animal no implicado en el conflicto presentaban una concentración plasmática de cortisol más baja que los animales que no redirigieron su agresividad (Virgin y Sapolsky, 1997).

Por otra parte, existe una segunda hipótesis de acuerdo con la cual la agresividad redirigida sería un signo de conflicto motivacional. Según esta hipótesis, el individuo estaría simultáneamente motivado a atacar y a huir, de forma que ambas motivaciones se inhibirían mutuamente, apareciendo entonces una tercera conducta que se denomina conducta de desplazamiento (Bastock et al., 1953; Kazem y Aureli, 2005). En los perros, por ejemplo, es frecuente que cuando dos individuos se enfrentan a través de una valla, uno de ellos ataque a un tercer individuo no involucrado en el conflicto o bien inicie una conducta de desplazamiento como perseguirse la cola (Bastock et al., 1953).

Según nuestros resultados, los gatos que no tienen acceso al exterior muestran agresividad redirigida más frecuentemente que los que pueden acceder al exterior. Una posible explicación es que los gatos que no pueden acceder al exterior están menos habituados a los ruidos o simplemente tienen menos posibilidades de alejarse del estímulo desencadenante.

Problemas de comportamiento del Cocker Spaniel Inglés (CSI)

Algunas razas de perros son atendidas más frecuentemente por problemas de comportamiento que otras. Concretamente, el Cocker Spaniel, el Pastor Alemán y el Yorkshire Terrier son las tres razas que se presentan con más frecuencia en nuestro servicio de etología. Otros estudios realizados en distintas áreas geográficas también han concluido que algunas razas presentan más problemas de comportamiento que otras (Mugford, 1984; Lund et al., 1996; Reisner et al., 2005; Takeuchi y Mori, 2006; Fatjó et al., 2007; Duffy et al., 2008).

Para poder calcular el factor de riesgo asociado a una determinada raza es imprescindible poder comparar la población problema con la población general, con objeto de descartar que las supuestas diferencias entre razas se deban sólo a diferencias en la abundancia relativa de una raza. En nuestro estudio utilizamos los datos cedidos por el archivo de identificación de animales de compañía. Así, mientras que el CSI supuso el 15% del total de perros de la población problema (es decir, de los perros con problemas de comportamiento) esta raza sólo suponía el 3.52 % del total de perros de raza de nuestra zona de estudio.

Por lo tanto, el CSI tiene un riesgo 5 veces mayor que un perro "promedio" de presentar un problema de comportamiento. Además, en nuestro estudio, los CSI agresivos atacan a sus propietarios en un porcentaje mayor de casos que los perros agresivos de otras razas (67,6% vs 36,5%). Otros trabajos han encontrado también que el CSI es una de las razas que presenta más problemas de agresividad hacia sus propietarios (Landsberg, 1991; Lund et al., 1996; Pageat, 1998; Beaver, 1999).

Estos resultados son importantes por varios motivos. En primer lugar, los problemas de agresividad son los problemas de comportamiento del perro más frecuentes (Beaver, 1994; Overall, 1997c; Landsberg, 1991; Fatjó et al., 2006). Por otro lado, el CSI es la raza que más problemas de agresividad presenta en nuestra zona de estudio. Otros autores, por el contrario, han observado una mayor prevalencia de problemas de agresividad en el Springer Spaniel (Landsberg, 1991; Reisner et al., 1994).

La diferencia entre el CSI y otras razas puede teóricamente deberse a factores genéticos, epigenéticos o ambientales (Brain, 2000; Mertens, 2002; Nelson, 2006). Recientemente se ha observado diferencias entre perros agresivos y no agresivos en la expresión de algunos genes en el sistema nervioso central y la expresión de dos genes, UBE2V2 y ZNF227, se asocia a un comportamiento agresivo (Vage et al., 2010). Estudios anteriores ya habían identificado diferencias en la secuencia de DNA entre distintas razas de perros en genes relacionados con el temperamento del animal (Niimi et al., 1999; Takeuchi et al., 2005; Vage y Lingaas, 2008). Sin embargo aunque todavía no hay estudios genéticos específicos en el CSI, casi la mitad de los perros agresivos incluidos en el estudio comentado anteriormente eran cockers (Vage et al., 2010).

La separación prematura del cachorro de su madre y hermanos, niveles de estrés elevados durante las primeras fases del desarrollo o una madre con un comportamiento maternal pobre pueden tener efectos negativos sobre el cachorro (Scott y Fuller, 1965; Weaver et al., 2004), aumentando los problemas de ansiedad y falta de inhibición de la mordedura (Beaver, 2009). No disponemos de datos que nos permitan confirmar que los problemas de agresividad en el CSI se deban a una cría inadecuada. Sin embargo, la popularidad de esta raza podría contribuir a una producción masiva de cachorros (Serpell y Jagoe, 1995). De hecho, según nuestros datos, los CSIs proceden más frecuentemente de tiendas que de otros lugares. En consecuencia, una separación prematura de la madre y una estancia prolongada en un entorno inadecuado podrían contribuir al desarrollo de estos problemas (Serpell y Jagoe, 1995).

Otro de los posibles motivos que explique el comportamiento agresivo del CSI es que los propietarios de perros de esta raza se comporten de forma diferente que los propietarios de otras razas. Es cierto que existen varios estudios, incluyendo algunos trabajos acerca de propietarios de CSI, que han encontrado una asociación entre las características del propietario y los problemas de comportamiento de su perro (O' Farell, 1995; Podberscek y Serpell, 1997a; Podberscek y Serpell, 1997b). Aún así, no

disponemos todavía de información suficiente para concluir que nuestros resultados se deban a diferencias entre los propietarios de CSI y los de perros de otras razas.

En relación a las diferencias entre machos y hembras, nuestros datos coinciden con los obtenidos por otros autores en el sentido de que los CSI machos presentan más frecuentemente problemas de agresividad que las hembras (Podberscek y Serpell, 1996). Tal como hemos explicado anteriormente, los machos de la mayoría de especies son más agresivos que las hembras (Borchelt, 1983; Wright y Nesselrote, 1987; Gershman et al., 1994; Nelson, 2000; Takeuchi et al., 2001; Fatjó et al., 2007).

Al comparar los CSI agresivos con una población de CSI no agresivos, observamos que los CSI de un solo color y de capa dorada suponían un porcentaje mayor en la población agresiva que en la no agresiva. Otros autores ya habían observado una relación entre el color de la capa y el comportamiento en esta raza, así como en el Labrador Retriever y en otras especies (Keeler, 1942; Cottle y Price, 1987; Porberscek y Serpell, 1996; Houpt y Willis, 2001).

Se han sugerido varias hipótesis para explicar esta relación. En primer lugar la melanina (pigmento responsable del color del pelaje) y las monoaminas (algunas de las cuales son neurotransmisores) podrían compartir una misma vía metabólica (Hemmer, 1990), de forma que los genes responsables del color de la capa actuaran también sobre el comportamiento. Una segunda posibilidad es que los genes responsables del color de la capa sean distintos de los genes responsables del comportamiento, pero al encontrarse muy próximos segreguen juntos (Keeler, 1942; Belyaev et al., 1981; Cottle y Price, 1987; Hayssen, 1997).

Diferencias en la actividad de serotonina (CSI)

Tal como explicado en la introducción, la serotonina es uno de los neurotransmisores más implicados en el comportamiento agresivo (Coccaro, 1989; Virkkunen y Linnoila,

1993; Higley et al., 1996). En el perro y en otras especies se ha observado una correlación entre niveles bajos de serotonina y agresividad, principalmente cuando existe un componente de impulsividad (Virkkunen et al., 1995; Reisner et al., 1996; Peremans et al., 2003; Cakiroglu et al., 2007; Rosado et al., 2010). De hecho, según nuestros resultados los CSI agresivos tienen una concentración sérica de serotonina inferior a la de perros agresivos de otras razas (318.6 ng/ml vs 852.77 ng/ml). Además, una disminución de la actividad de la serotonina se relaciona especialmente con la agresividad impulsiva y según nuestros resultados el CSI muestra agresividad impulsiva más frecuentemente que otras razas (43.7 % vs 30.9 % de los perros agresivos de otras razas). Sin embargo es importante tener en cuenta que se trata de resultados preliminares que deberían confirmarse ampliando el número de animales estudiados, caracterizando los tipos de agresividad que muestran los animales del estudio y, finalmente, incluyendo también CSI no agresivos.

La posible menor actividad de serotonina en el CSI podría deberse a varias causas. Así, por ejemplo, algunos estudios realizados en otras razas indican una asociación entre determinados polimorfismos genéticos y algunos rasgos de carácter (Niimi et al., 1999; Hejjas et al., 2007) y, tal como hemos comentado antes, no podemos descartar este mecanismo en el caso del CSI.

Otra posibilidad especialmente interesante está relacionada con la corteza orbitofrontal, que es el área de la corteza prefrontal responsable del comportamiento emocional y social. La corteza orbitofrontal es muy rica en neuronas serotoninérgicas (Fuster 1990, 2000; Seo et al., 2008; Gansler et al., 2009) y las lesiones en esta zona se correlacionan con comportamientos anormales, entre ellos agresividad e impulsividad (Giancola, 1995; Rolls, 2000; Brower y Price, 2001). Aunque es poco probable que el CSI muestre una mayor prevalencia de patologías en la corteza orbitofrontal que los perros de otras razas, existe un mecanismo alternativo que no puede descartarse y que está relacionado con la lateralización del sistema nervioso central. En efecto, mientras que el hemisferio izquierdo es responsable del control de la conducta agresiva, el

hemisferio derecho tiene sobre todo una acción inhibitoria (Aron et al., 2004). Así, por ejemplo, en personas esquizofrénicas se ha observado una correlación positiva entre la agresividad y el volumen de materia gris en la corteza orbitofrontal izquierda (Hoptman et al., 2005). Aunque se trata sólo de una hipótesis especulativa, creemos que sería interesante estudiar este aspecto en el CSI.

El ejercicio físico aumenta la actividad de serotonina y existe una correlación negativa entre agresividad y actividad física (Jagoe y Serpell, 1996; Chaouloff, 1997; Tsatsoulis y Fountoulakis, 2006). Así, en un estudio preliminar se observó que los perros agresivos hacían menos ejercicio (menos paseos y de menor duración) que los no agresivos (Mariotti et al., 2009). No puede descartarse, por lo tanto, que la supuesta menor actividad de serotonina en el CSI sea consecuencia de una actividad física inferior a la de perros de otras razas.

Finalmente podríamos sospechar que algunas prácticas de manejo estresantes sean más frecuentes en el CSI que en perros de otras razas. Tal como hemos explicado anteriormente, algunos autores observaron una asociación entre la personalidad del propietario y el comportamiento agresivo del CSI (Podberscek y Serpell, 1997b). Existe por lo tanto la posibilidad de que los propietarios de CSI traten a sus animales de una forma más estresante (por ejemplo, aplicando castigos de forma inadecuada), de modo que la disminución de la actividad de serotonina fuera consecuencia de una respuesta de estrés crónico en el animal (Mellor et al., 2000).

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CONCLUSIONES

1. Los problemas de agresividad y los problemas de eliminación inadecuada suponen la mayoría de las consultas de etología clínica felina recibidas en el Servicio de Etología de la *Fundació Hospital Clínic Veterinari*. Los problemas de agresividad entre gatos son más frecuentes que los problemas de agresividad hacia las personas. En relación a los problemas de agresividad hacia las personas, los miembros de la familia son el blanco más frecuente.

2. Dentro de la categoría de problemas de eliminación inadecuada, los más frecuentes son los de micción inadecuada, seguidos por los problemas que afectan tanto a la micción como a la defecación y finalmente por los que afectan a la defecación. Los gatos de raza Persa presentan significativamente más problemas de eliminación inadecuada que las otras razas.

3. En la categoría de problemas de agresividad, los dos diagnósticos más comunes son la agresividad por falta de tolerancia a la manipulación y la agresividad por juego. En la categoría de problemas de eliminación inadecuada, el diagnóstico más común son los problemas de aversión a la bandeja. Estos resultados indican que el desconocimiento de los propietarios acerca del comportamiento normal del gato contribuye en muy buena medida al desarrollo de problemas de comportamiento en esta especie.

4. Según la base de datos del Servicio de Etología, los gatos que proceden de tiendas, que no tienen acceso al exterior y que no conviven con otros gatos, presentan significativamente más problemas de comportamiento. El primero de estos resultados sugiere que una socialización deficiente es un factor importante en el desarrollo de los problemas de comportamiento del gato.

5. Las gatas no castradas presentan más problemas de agresividad que las castradas. No hay diferencias entre machos y hembras en la prevalencia de problemas de comportamiento. Estos resultados indican que los factores hormonales desempeñan un papel diferente en la agresividad del gato y la del perro.

6. El 9% de los casos de comportamiento agresivo del gato analizados en este trabajo son compatibles con un diagnóstico de agresividad redirigida. Los sonidos intensos y las interacciones con otros gatos son los detonantes más comunes. Los propietarios y otros gatos de la vivienda son los blancos alternativos más frecuentes. En la mayoría de episodios de agresividad redirigida el gato adopta una postura defensiva. Los gatos que muestran agresividad redirigida no suelen tener acceso al exterior y presentan frecuentemente fobia a los ruidos. Estos resultados sugieren que el mecanismo responsable de la agresividad redirigida del gato está relacionado con la respuesta de miedo y estrés.

7. Según la base de datos del Servicio de Etología de la *Fundació Hospital Clínic Veterinari*, el Cocker Spaniel Inglés es la raza que presenta más problemas de agresividad. La agresividad hacia la familia es el problema que se presenta con más frecuencia en esta raza. Los machos presentan significativamente más problemas de agresividad que las hembras y los individuos de capa dorada presentan más problemas de agresividad que los individuos de otras capas. Este último resultado sugiere que el Cocker Spaniel Inglés es un buen modelo para estudiar la relación entre el color de la capa y el temperamento en los animales.

8. Al comparar una población de perros de raza Cocker Spaniel Inglés con una población de perros de otras razas, ambas con problemas de agresividad, se observa que la impulsividad es una característica más frecuente en la población de Cockers.

9. La concentración sérica de serotonina inferior en perros agresivos de raza Cocker Spaniel Inglés que en perros agresivos de otras razas. Los dos resultados anteriores indican que el Cocker Spaniel Inglés podría ser un buen modelo para estudiar los mecanismos fisiológicos responsables de la impulsividad.