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Preferencias sexuales típicas y atípicas según sexo y edad de los estímulos: utilidad de la técnica de rastreo ocular

Typical and atypical sexual preferences according to sex and stimuli age: Utility of the Eye Tracking Technique

Tesis doctoral/PhD thesis

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HACEN CONSTAR que

Doña Milena Vásquez Amézquita, licenciada en Psicologia y master en Neurociencias Básicas y Aplicadas por la Universidad de Valencia, ha realizado bajo su supervisión la tesis doctoral titulada "Preferencias sexuales típicas y atípicas según sexo y edad de los estímulos: utilidad de la técnica de rastreo ocular" y, que una vez revisada, autorizan su depósito para ser presentada y optar al Grado de Doctor.

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"Lo más erótico que existe es el cerebro. Uno se enamora con el cerebro"
Rodolfo Llinás
Neurocientífico colombiano

… yo agregaría que "*uno se enamora del cerebro*".

Este camino, que no ha sido corto y no ha sido fácil, ha sido también el más apasionante y formativo de mi carrera, he crecido como profesional, como científica y sin duda alguna como persona.

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PREFACIO

Entre los temas científicos más polémicos se encuentran las preferencias sexuales; desde las típicas, orientadas al sexo opuesto, pasando por las no normativas, que se relacionan con la orientación hacia el mismo sexo, hasta las más controvertidas actualmente, como las preferencias sexuales desviadas o parafilias. Sin embargo, como lo expresan Bailey et al (2016) mientras más políticamente controvertido sea un tema, mayor interés público debe despertar estudiarlo de forma explícita e imparcial, y la única forma de hacer esto es usando el método científico.

La comprensión de la sexualidad humana ha ido avanzando de la mano del progreso científico, pero también de las presiones ambientales, que han obligado a los investigadores a ocuparse de las diversas expresiones fenotípicas de la sexualidad, dado que en muchos casos suponen consecuencias dramáticas personales y sociales; entre ellas disfunciones sexuales en personas con preferencias sexuales típicas, desequilibrios emocionales en personas con preferencias sexuales hacia el mismo sexo, y conductas sexuales desviadas en pedófilos y delincuentes sexuales. Estudiar científicamente las preferencias sexuales contribuye a reducir el impacto de estas problemáticas en los individuos y la sociedad.

La dificultad de hacer investigación acerca de las preferencias sexuales típicas y atípicas, pero también la necesidad inminente de aproximarse a su comprensión, han llevado a psicólogos experimentales, neurocientíficos y otros investigadores a trabajar en el desarrollo de herramientas confiables, no invasivas, de bajo costo y éticas, que permitan a la mayoría de personas participar libremente y con menos restricciones en la investigación sobre sexualidad, además de controlar los sesgos por deseabilidad social que implican las medidas de autoreporte, y que se acentúan en personas con preferencias sexuales atípicas y conductas sexuales ilegales. Los paradigmas atencionales con

estímulos relevantes sexualmente, y la técnica de *eye tracking* son nuevos mecanismos en estudio para la identificación de preferencias sexuales humanas, que no requieren de la conciencia del sujeto acerca del fenómeno evaluado y elicitan respuestas relativamente automáticas. Estas técnicas resultan prometedoras en la evaluación de agresores sexuales (Snowden, Craig, & Gray, 2011).

Teniendo en cuenta lo anterior esta tesis doctoral presenta evidencia sobre la utilidad de los paradigmas atencionales y la técnica de rastreo ocular en la identificación de preferencias sexuales típicas y atípicas, estas últimas no desviadas y desviadas, como la pedofilia, altamente riesgosa para conductas sexuales como el abuso sexual infantil.

El primer capítulo contiene una revisión conceptual y empírica general. Se divide en cinco partes. La primera parte describe el modelo de procesamiento de la información del arousal sexual que fundamenta el uso de paradigmas atencionales para acceder a procesos cognitivos tempranos y tardíos subyacentes a las preferencias sexuales. En la segunda parte se define la clasificación de la respuesta sexual de categoría específica y no-especifica, para entender las diferencias dependientes del género, en la correspondencia entre las preferencias sexuales y el arousal sexual. En la tercera parte, se presenta una delimitación conceptual de las preferencias sexuales atípicas, centrándose específicamente en la pedofilia y la agresión sexual. En la cuarta parte, se abordan las teorías explicativas del arousal sexual, profundizando en la hipótesis de la acción organizacional-activacional de las hormonas sexuales y su rol en la explicación de las preferencias sexuales. En la quinta parte, se describen los tipos de medidas de las preferencias sexuales: directas e indirectas, fundamentando el uso de la técnica de *eye tracking* en el estudio de las preferencias sexuales.

El segundo capítulo incluye los principales objetivos e hipótesis de esta tesis y que se desarrollan a lo largo de los tres estudios empíricos presentados en los capítulos siguientes.

El tercer capítulo presenta evidencia acerca de la utilidad de la técnica de eye tracking para identificar preferencias sexuales de categoría específica y no-específica en hombres y mujeres ginéfilos y andrófilos, utilizando un paradigma de visualización libre de estímulos sexuales en competencia en dos experimentos en los que se manipuló, en el primero, el sexo de los estímulos y en el segundo, la edad de los estímulos.

En el cuarto capítulo se busca evidencia de la posible influencia de la exposición prenatal a la testosterona sobre la especificidad de la respuesta sexual, utilizando como marcador biológico la proporción 2D:4D. Específicamente se exploró la relación entre la proporción 2D:4D y la respuesta sexual de hombres y mujeres ginéfilos y andrófilos, medida a través del patrón de rastreo ocular sobre estímulos sexualmente preferidos.

En el capítulo quinto, teniendo en cuenta la evidencia de la utilidad de la técnica de rastreo ocular en la identificación de preferencias sexuales típicas, se pone a prueba el paradigma de visualización de estímulos usando dicha técnica en la discriminación de agresores sexuales de niños, de otro tipo de agresores y comunidad general.

El capítulo sexto contiene una discusión general y las principales conclusiones, limitaciones y propuestas futuras para la investigación relacionada con la técnica de *eye tracking* en el estudio de las preferencias sexuales típicas y atípicas.

El capítulo séptimo incluye las conclusiones de la tesis y el capítulo final presenta las referencias bibliográficas. Se anexan los artículos originales.

THESIS OUTLINE

Among the most controversial scientific topics are sexual preferences; from the typical, oriented to the opposite sex, passing through the non-normative ones, which are related to the orientation towards the same sex, to the most controversial at present, such as sexual preferences deviated or paraphilics. However, as expressed by Bailey et al (2016), the more politically controversial a topic is, the more public interest it should be to study it explicitly and impartially, and the only way to do this is by using the scientific method.

The understanding of human sexuality has progressed hand in hand with scientific progress, but also environmental pressures, which have forced researchers to deal with the various phenotypic expressions of sexuality, since in many cases they involve dramatic personal consequences and social; These include sexual dysfunctions in people with typical sexual preferences, emotional imbalances in people with same-sex sexual preferences, and deviant sexual behaviours in paedophiles and sex offenders. Studying sexual preferences scientifically helps reduce the impact of these problems on individuals and society.

The difficulty of doing research about typical and atypical sexual preferences, but also the imminent need to approach their understanding, have led experimental psychologists, neuroscientists and other researchers to work on the development of reliable, non-invasive, low-cost tools and ethics, which allow the majority of people to participate freely and with less restrictions in sexuality research, in addition to controlling the biases for social desirability that self-report measures imply, and which are accentuated in people with atypical sexual preferences and illegal sexual behaviours Attention paradigms with sexually relevant stimuli, and the eye tracking technique are part of new mechanisms under study for the identification of human sexual preferences,

which do not require the subject's awareness of the evaluated phenomenon and elicit relatively automatic responses. These techniques are promise in the evaluation of sexual offenders against children (Snowden et al., 2011).

This doctoral thesis presents evidence on the usefulness of attentional paradigms and the eye tracking technique in the identification of typical and atypical sexual preferences, the latter no-deviants and deviants, like paedophilia, highly risky for sexual behaviours such as child sexual abuse.

The first chapter contains a general conceptual and empirical review. It is divided into five parts. The first part describes the information processing model of sexual arousal that bases the use of attentional paradigms to access early and late cognitive processes underlying sexual preferences. In the second part, the classification of the sexual response of specific and non-specific categories are defined to understand the gender-dependent differences in the correspondence between sexual preferences and sexual arousal. In the third part, a conceptual delimitation of atypical sexual preferences is presented, focusing specifically on pedophilia and sexual aggression. In the fourth part, the explanatory theories of sexual arousal are discussed, deepening in the hypothesis of the organizational-activational action of the sexual hormones and their role in the explanation of sexual preferences. In the fifth part, the types of measures of sexual preferences are described in two categories: direct and indirect, based on the use of the eye tracking technique in the study of sexual preferences.

The second chapter includes the main objectives and hypotheses of this thesis and that are developed throughout the three empirical studies presented in the following chapters.

The third chapter presents evidence about the usefulness of the eye tracking technique to identify specific and non-specific categories of sexual preferences in

gynephilic and androphilic men and women, using a free viewing paradigm of competing sexual stimuli in two experiments, manipulating the sex and age of the stimuli, respectively.

In the fourth chapter, evidence is sought regarding the possible influence of prenatal testosterone exposure on the specificity of the sexual response, using the 2D:4D ratio as a biological marker. Specifically, the relationship between the 2D:4D ratio and the sexual response of gynephilic and androphilic men and women, measured through eye tracking patterns on sexually preferred stimuli, was explored.

In chapter five, and considering the evidence of the usefulness of the eye tracking technique in the identification of typical sexual preferences, the paradigm of stimuli viewing using the eye tracking methodology in the discrimination of sexual offenders against children, from other types of offenders and general community is tested.

The sixth chapter contains a general discussion, the main conclusions, limitations and suggestions for future research related to the technique of eye tracking in the study of typical and atypical sexual preferences.

The seventh chapter includes the conclusions of the thesis and the final chapter presents the bibliographical references. The original articles are attached.

Tabla de Contenido

ABREVIATURAS

NE = Norepinefrina

DA = Dopamina

5HT = Serotonina

NTs = Neurotransmisores

DSM V = Diagnostic and Statistical Manual of Mental Disorders - V

2D- 4D = Digit two and Digit four

IAT = Implicit Association Test

IRAP = Relational Assessment Procedure

RSVP = Rapid Visual Serial Presentation

TFF = Time to First Fixation

TDF = Total Duration of Fixation

CF= Count Fixation

AT = Adult Targets

CT = Child Targets

AOI = Area of Interest

MT = Male Targets

FT = Female Target

TA = Target Age

TS = Target Sex

PS = Participant Sex

PSO = Participant Sexual Orientation

And =Androphilic

Gyn =Gynephilic

SOAC = Sexual Offenders Against Children

SOAA = Sexual Offenders Against Adults

NSO = Nonsexual Offenders

NOM = Nonoffending Men

CAPÍTULO 1. INTRODUCCION GENERAL

1.1 Modelo de procesamiento de la información del Arousal Sexual

El arousal sexual se define como una experiencia emocional-motivacional que involucra procesos fisiológicos (respuesta genital), cognitivo-afectivos (valoración subjetiva) y conductuales (tendencia a la acción y conducta motora; Janssen, 2011; Janssen & Bancroft, 2007; Rosen & Beck, 1988). Incluye tanto el arousal subjetivo como el arousal genital. El arousal subjetivo se conceptualiza como una experiencia emocional que incluye tres componentes: activación autonómica, expectativa de recompensa y deseo motivado (Everaerd, 1989). El arousal genital corresponde con la respuesta fisiológica dada por la dilatación de los vasos sanguíneos que irrigan los tejidos genitales. En los hombres resulta en la erección y en las mujeres en la dilatación vaginal y la lubricación (de Jong, 2009).

Se ha demostrado que la respuesta sexual subjetiva no siempre coincide con la respuesta genital. Incluso en presencia de alta excitación genital, la excitación subjetiva puede ser baja. Lo que sugiere que la respuesta genital está fuertemente ligada al estímulo sexual relevante, pero la respuesta sexual subjetiva puede ser variable y susceptible a factores situacionales. Estas disparidades en los componentes del arousal sexual revelan la existencia de mecanismos de control subyacentes diferenciales entre ambos componentes (Bancroft, 1989).

Dado que los procesos atencionales aseguran la identificación de estímulos relevantes para la supervivencia, ya sean aversivos o apetitivos, la atención juega un rol

importante en la obtención de información reproductiva y la selección de señales relevantes para la elección de pareja y la reproducción exitosa (Krupp, 2008). Por lo que la atención visual juega un papel importante en los modelos de arousal sexual. Para entender los mecanismos que subyacen a la comprensión del arousal sexual, se han propuesto teorías basadas en el rol de la atención en el arousal sexual que han permitido aproximarse a la comprensión de la interacción entre los componentes subjetivo y fisiológico que determinan la respuesta sexual (de Jong, 2009). Janssen y Everaerd (1993) plantean que el arousal sexual no puede ser tratado como un constructo unificado sin tener en cuenta las variaciones entre sus componentes. Según Spiering y Everaerd (2007) un estímulo no es en sí mismo sexual, sino que se transforma en sexual según la experiencia sexual subjetiva particular. Esta experiencia sexual subjetiva surge de un "mensaje cognitivo" ya transformado que depende de factores biológicos, como hormonas andrógenas y neurotransmisores (Norepinefrina - NE y Dopamina - DA) y factores psicológicos, según la valoración que se da al estímulo.

El modelo de arousal sexual de Spiering y Everaerd (2007) plantea que la interacción entre los procesos atencionales y la memoria determinan la experiencia sexual subjetiva y fisiológica en la respuesta sexual humana. La atención en lo relacionado con la excitación sexual, se rige por procesos de abajo-arriba (automáticos) y de arriba-abajo (controlados; de Jong, 2009) regulados por la amígdala y la corteza frontal, respectivamente (Compton, 2003), lo que le da sentido a la relación entre atención y arousal sexual. Por esta razón el modelo involucra procesos atencionales automáticos y controlados. Así, siguiendo a Spiering, Everaerd y Elzinga (2002), un estímulo sexual activa automáticamente el sistema sexual que lleva a una respuesta genital, a través de un proceso pre-atencional de las características relevantes del estímulo, que disparan una atención automática y activan la memoria sexual implícita que contiene información

biológica acerca del estímulo relacionada con reflejos innatos ya automatizados, y sensaciones condicionadas (aprendidas e instauradas automáticamente); estos condicionamientos y por consiguiente, el significado del estímulo, depende de las circunstancias o historia de cada individuo. Si las características del estímulo coinciden con las almacenadas en la memoria implícita, la excitación fisiológica se produce automáticamente (proceso de abajo-arriba). Por su parte, si el arousal sexual fisiológico es llevado a la consciencia se induce un proceso atencional focal consciente de las características de ese estímulo; si estas corresponden con guiones sexuales almacenados en la memoria explícita, se da una evaluación consciente de los aspectos del estímulo y la experiencia sexual subjetiva. Esta evaluación depende del contenido de la información almacenada en la memoria explícita que involucra recuerdos de encuentros sexuales, actitudes hacia el sexo, fantasías sexuales y conocimiento sobre la recompensa o costo sexual. Cuando ocurre esta activación, se produce una atención voluntaria hacia el estímulo sexual que da, como resultado, una respuesta sexual completa y una consciencia de la excitación sexual (proceso arriba-abajo). Para Spiering, Everaerd y Laan (2004) el arousal sexual se basa en la pre-selección y evaluación de estímulos, y esta evaluación involucra procesos de memoria, regulación y atención que trabajan de forma integrada.

El arousal sexual está ligado a nivel central a la activación de la ínsula y la corteza orbitofrontal; sin embargo, la ínsula no parece estar especializada sólo en emociones sexuales, sino que también se activa en emociones como ansiedad, desagrado o enojo, por lo que su rol parece ser representar la excitación autonómica periférica que determina la entrada a la consciencia de los estados emocionales. Entonces el procesamiento automático del estímulo sexual lleva al organismo a prepararse para la acción, pero una vez tomamos consciencia de los cambios fisiológicos, gracias a la retroalimentación del cerebro, se da la experiencia sexual y el deseo (disposición a comportarse sexualmente).

De esta manera, sin un estímulo apropiado que active la excitación sexual (conciencia genital y evaluación subjetiva de la situación), no ocurrirá el deseo o tendencia a la acción sexual (Both, Everaerd, & Laan, 2007).

La atención permite tomar conciencia clara y vívida del significado de los estímulos, y acceder a estos significados afecta directamente la excitación fisiológica y subjetiva (de Jong, 2009). Los procesos atencionales automáticos y controlados serían, por lo tanto, un buen indicador de excitación y deseo sexual, permitiendo predecir patrones de excitación sexual diferenciales. Si un estímulo tiene significado sexual para el sujeto, éste adquiere la capacidad de disparar un proceso inicial inconsciente seguido de un proceso de atención consciente que podría influir sobre la decisión de aproximarse al estímulo y, a su vez, sobre la autorregulación frente al mismo (Krupp, 2008).

1.2 Respuesta sexual humana: específica vs inespecífica

Se ha demostrado que existen diferencias entre sexos en el arousal sexual y patrones de respuesta asociados, que involucran variaciones físicas, psicológicas y psicofisiológicas. Nuevos modelos específicos según el sexo han venido emergiendo recientemente para explicar estas diferencias y aproximarse a la comprensión de la sexualidad humana atendiendo a las diferencias de género (Chivers, 2005).

La diferencia en la correspondencia entre las preferencias sexuales y el arousal sexual representa una de las diferencias psicofisiológicas dependientes del género que ha llevado a clasificar la respuesta sexual como de categoría especifica o no-especifica (Chivers, 2005). Según Chivers, Seto, Lalumière, Laan y Grimbos (2010) una respuesta sexual específica se referiría a un patrón de respuesta mayor hacia el estímulo preferido

sexualmente, es decir, que coincide con la orientación sexual del individuo. Mientras que una respuesta sexual no-específica se define como un patrón de respuesta sexual similar hacia ambos estímulos, preferido y no preferido, es decir, no hay correspondencia entre la respuesta sexual y la orientación sexual reportada.

1.2.1 Especificidad según el sexo de los estímulos

Según el sexo del estímulo preferido sexualmente, las preferencias de hombres y mujeres hacia el sexo opuesto, se denominan preferencias sexuales típicas, ya que representan a la población general. Dado que las preferencias sexuales de hombres y mujeres hacia el mismo sexo, no hacen parte del promedio de la población, se pueden denominar preferencias sexuales atípicas no desviadas. El arousal sexual de los hombres es de categoría específica según el sexo del estímulo, evidenciando mayor excitación sexual hacia estímulos de categorías con quienes ellos prefieren tener sexo (Chivers, Rieger, Latty, & Bailey, 2004). Este patrón de respuesta se ha evidenciado tanto en hombres ginéfilos, o atraídos sexualmente por mujeres, como andrófilos, o atraídos sexualmente por hombres (Chivers, 2017), utilizando diferentes técnicas, además de las técnicas basadas en la medición genital, como el rastreo ocular (Lykins, Meana, & Strauss, 2008), la dilación pupilar (Rieger & Savin-Williams, 2012) o el tiempo de visualización (Ebsworth & Lalumière, 2012). Por el contrario, en mujeres, andrófilas y ginéfilas inicialmente se encontró una respuesta sexual genital no-específica (Chivers et al., 2004), similar hacia estímulos de ambos sexos. No obstante, recientemente Chivers, Bouchard y Timmers (2015) encontraron que la respuesta sexual genital no-específica es exclusiva de las mujeres andrófilas, pero podría variar según las características de los estímulos presentados, por ejemplo, la intensidad del estímulo (genitales excitados) o de las escenas presentadas (altamente eróticas).

La excitación sexual masculina parece estar fuertemente ligada a las características sexuales relevantes presentes en el estímulo sexual preferido y al contenido sexual y erótico de la información (Hewig, Trippe, Hecht, Straube, & Miltner, 2008). Esta especificidad en la respuesta sexual masculina ha llevado a los investigadores a medir los patrones de excitación genital para identificar preferencias sexuales en hombres que pueden estar interesados en negar u ocultar estas preferencias, ya sea en relación con el sexo, como las preferencias homosexuales o en relación con la edad de los estímulos, como por ejemplo en el caso de hombres con intereses sexuales pedófilos, es decir, hacia niños pre-púberes (Chivers et al., 2004).

La respuesta sexual femenina parece no estar ligada necesariamente al sexo preferido y podría depender de otro tipo de información contextual o de aspectos no sexuales de los estímulos (Lykins, Meana, & Kambe, 2006; Lykins et al., 2008). Por lo que la sexualidad femenina podría mostrar mayor plasticidad y variabilidad en el tiempo en relación con los comportamientos sexuales (Baumeister, 2000). Es por esto que la experiencia sexual no-específica según el sexo preferido en las mujeres parece contradecir los modelos dominantes de la respuesta sexual que asumen que sólo el estímulo que coincide con la preferencia sexual puede activar la respuesta sexual, lo que ha tenido impacto en la comprensión de la sexualidad femenina y las disfunciones sexuales (Chivers, 2017).

1.2.2 Especificidad según la edad de los estímulos

Es posible hablar de especificidad de la respuesta sexual según la edad de los estímulos. El arousal sexual en condiciones típicas, es decir, cuando existe una preferencia sexual de un adulto por otro adulto, es específico hacia estímulos adultos con características sexuales maduras para la reproducción (Ebsworth & Lalumière, 2012); sin

embargo, en condiciones atípicas como sería el caso de hombres con intereses sexuales pedófilos, la respuesta sexual puede ser específica pero hacia estímulos infantiles pre-púberes. Estas preferencias se consideran atípicas desviadas.

Los primeros métodos para identificar preferencias sexuales según la edad fueron utilizados en muestras de abusadores sexuales de niños y se realizaron a través de pletismografía peneana (Bancroft, Jones, & Pullan, 1966), un procedimiento para medir objetivamente el arousal sexual normal y anormal (parafilias) en hombres (Murphy et al., 2015), que consiste en registrar los cambios en el flujo sanguíneo del pene, permitiendo visualizar cambios relativos en la circunferencia de éste durante la presentación de estímulos sexuales de diferentes edades (Tenbergen et al., 2015), según la clasificación del esquema corporal de Tanner (1962). A través de este método se ha logrado comprobar que quienes tienen preferencias sexuales hacia los niños presentan aumento del arousal sexual frente a estímulos infantiles pre-puberales (Laws, Hanson, Osborn, & Greenbaum, 2000; Murphy et al., 2015). Consistente con estos hallazgos y a través del uso de paradigmas de visualización se ha encontrado que personas con intereses sexuales pedófilos presentan sesgos cognitivos hacia estímulos infantiles que guían su atención pre-consciente hacia estos estímulos (Fromberger et al., 2013; Fromberger, Jordan, Steinkrauss, et al., 2012). En personas sin intereses sexuales desviados los hallazgos, utilizando técnicas como pupilometría y tiempo de visualización, dan soporte a que hombres y mujeres de cualquier preferencia sexual interesados en adultos presenten patrones de atención específicos hacia estímulos adultos sexualmente maduros, y no hacia niños (Attard, Bindemann, & Ciardha, 2016; Ebsworth & Lalumière, 2012).

1.3 Preferencias sexuales atípicas desviadas: pedofilia y agresión sexual

Como se mencionó, las preferencias sexuales típicas corresponden a las preferencias hacia estimulos adultos con características sexuales maduras. Dentro de las preferencias típicas, según el sexo y edad de los estímulos, se encuentran la ginefilia y androfilia. La ginefilia hace referencia a la preferencia erótica por las características físicas maduras de la mujer, y la androfilia se refiere a la preferencia erótica por las características fisicas maduras del hombre (Freund & Blanchard, 1989). Según la hipotesis de la preferencia sexual desviada, los hombres abusadores de niños tienen preferencias sexuales hacia los niños y los hombres violadores de mujeres tienen preferencias por el sexo forzado (Akerman & Beech, 2012; Freund & Blanchard, 1989); estas preferencias sexuales traen como consecuencia un arousal sexual desviado y aumentan el riesgo de agresión sexual. Esta hipótesis ha sido limitada, ya que en el caso de los abusadores sexuales de niños, no todos tienen una preferencia sexual hacia los niños, y de igual manera no todos aquellos con preferencias sexuales hacia los niños, terminan convirtiéndose en delincuentes sexuales (Seto, 2008).

Según la distinción de Snowden, Craig, y Gray (2011), los delincuentes sexuales de adultos son personas denominadas “violadores” que fuerzan a un adulto sin su consentimiento a un acto sexual. Los delincuentes sexuales de niños son personas, en su mayoría del sexo masculino, que sostienen, persuaden o fuerzan a un acto sexual a otras personas por debajo de la edad legal para consentir una relación sexual. Sin embargo, los pedófilos son sólo una parte de este grupo más amplio de delincuentes.

La pedofilia, según la clasificación del DSM V actual, debe distinguirse como preferencia y como trastorno. Como preferencia se considera un fenotipo de las

preferencias sexuales humanas, similar a las personas que prefieren a personas del mismo sexo, sólo que en este caso las preferencias se dan según la edad del estímulo, y no según el sexo. Así, la pedofilia puede ser definida como la atracción erótica hacia el esquema corporal de niños pre-púberes en etapas 1 (pre-pubertad, carencia total de características secundarias sexuales) y 2 (aparición de mamas y crecimiento testicular) de Tanner (Blanchard, 2010; Seto, 2009; Tanner, 1962).

La pedofilia se convierte en un trastorno o desorden de la preferencia sexual, cuando estas preferencias desencadenan problemas o deterioro significativo por fantasías y urgencias por actuar en consecuencia, incluyendo el consumo de pornografía o la comisión de delito de abuso sexual infantil, lo que daría cuenta de que las fantasías no son suficientes para satisfacer sus deseos sexuales (Blanchard, 2010; Tenbergen et al., 2015). Según Blanchard (2010), sólo el 50% de pedófilos tienen el riesgo de terminar en abuso sexual infantil. Por lo que no todos los delincuentes sexuales son pedófilos, o viceversa. Dentro del grupo de delincuentes sexuales también se pueden encontrar razones diferentes a la pedofilia para la agresión sexual como, por ejemplo, falta de experiencia sexual en adolescentes, personas con retraso mental, personas con trastornos de personalidad antisocial o trastornos de control de impulsos (Tenbergen et al., 2015). La pedofilia es inexistente entre mujeres, por lo cual la mayoría de la literatura se refiere a pedofilia en hombres (Blanchard et al., 2007).

1.4 Teorías explicativas del arousal sexual desviado en la agresión sexual

Las preferencias sexuales atípicas, al igual que las preferencias sexuales típicas, estarían dadas por procesos cognitivos subyacentes implícitos (ej. reflejos innatos

automatizados, sensaciones condicionadas) y explícitos (ej. actitudes hacia el sexo, fantasías sexuales, recompensa-costo sexual). En el estudio de la cognición del agresor sexual con preferencias sexuales desviadas, las teorías más recientes están de acuerdo en la existencia de una desviación o anormalidad cognitiva responsable del inicio y mantenimiento de la conducta de agresión sexual (Mann & Beech, 2003; Ward & Beech, 2006; Ward & Casey, 2010). Estas desviaciones cognitivas tendrían origen multicausal pudiendo integrar factores genéticos, estresores a lo largo de la vida y procesos de aprendizaje, alteraciones estructurales a nivel neurológico y eventos del neurodesarrollo que podrían llevar a una expresión atípica de las preferencias sexuales humanas (Tenbergen et al., 2015), por lo que la pedofilia no puede ser explicada desde una única perspectiva.

Es posible resumir las principales explicaciones del arousal sexual desviado en cinco factores: 1) factores del neurodesarrollo; 2) factores géneticos y epigéneticos; 3) aprendizaje y eventos vitales; 4) desequilibrio neuroquímico; y 5) alteraciones funcionales y estructurales en el cerebro (Snowden et al., 2011; Tenbergen et al., 2015).

1.4.1 Neurodesarrollo: Hipótesis organizacional-activacional

Dentro de los factores del neurodesarrollo responsables de las variaciones en las preferencia sexuales, y a partir de la hipótesis organizacional-activacional de Phoenix, Goy, Gerall y Young (1959; Phoenix, 2009), se ha propuesto que la exposición prenatal y postnatal a la testosterona regula la masculinización de las redes neurales en los hombres, mientras que una ausencia de estos efectos lleva al desarrollo fenotípico neural de las mujeres. Los efectos de la testosterona ocurren entre las semanas 12 y 18 de la gestación y los dos primeros meses después del nacimiento; durante estos periodos

críticos la testosterona influye directamente en la organización cerebral (Tenbergen et al., 2015). Según Phoenix, sus niveles no sólo determinan el comportamiento si no también el crecimiento óseo de los dedos, específicamente el cuarto y segundo, los cuales varían en su longitud según los niveles de exposición a la testosterona, por lo que la proporción entre los dedos 2 y 4 de las manos se ha convertido en indicadora de los niveles de testosterona prenatal. Estas diferencias neuroendocrinas se manifiestan después de la pubertad.

La ratio 2D:4D, cociente de la longitud de los dedos índice (2D) y anular (4D) (Brown, Finn, Cooke, & Breedlove, 2002) ha evidenciado ser menor en hombres que en mujeres (Csatho et al., 2003; Lutchmaya, Baron-Cohen, Raggatt, Knickmeyer, & Manning, 2004; Manning et al., 2000). Así, los hombres tienen relativamente más cortos los segundos (índices) que los cuartos dedos (anulares) de la mano, lo que representa mayores niveles de testosterona prenatal o una mayor sensibilidad a andrógenos, o ambas (A. A. Bailey & Hurd, 2005).

Aunque los mecanismos que subyacen a la influencia de los andrógenos sobre el crecimiento de los dedos aún no son claros, evidencia reciente manipulando el balance hormonal en monos ha puesto de manifiesto que la inactivación de los receptores androgénicos disminuye el crecimiento del cuarto dedo de la mano, causando altas ratios (femeninas), mientras que la inactivación del receptor estrogénico incrementa el crecimiento de este mismo dedo causando bajas ratios (masculinas). Estos hallazgos sugieren que la proporción de los dedos sería el sello de la exposición hormonal prenatal a lo largo de la vida (Zheng & Cohn, 2011). Sin embargo, la evidencia respecto a la asociación entre la ratio 2D:4D y las preferencias sexuales hacia el mismo sexo (Grimbos, Dawood, Burriss, Zucker, & Puts, 2010; Lippa, 2003; John T. Manning & Quinton, 2007; Rahman, 2005) y hacia el uso de la fuerza en el sexo (A. A. Bailey & Hurd, 2005; Ellis

& Hoskin, 2015) es escasa e inconsistente, y, en el caso de las preferencias sexuales pedófilas es inexistente (Jordan, Fromberger, Stolpmann, & Müller, 2011; Tenbergen et al., 2015).

Respecto a las diferencias en el arousal sexual típico del sexo, en base a hallazgos previos sobre la no-especificidad de la respuesta sexual de mujeres exclusivamente heterosexuales (S. J. Dawson & Chivers, 2016; Hamann et al., 2014), Chivers (2017) hipotetizó que la baja exposición a la testosterona prenatal podría explicar los patrones de respuesta sexual no específicos según el sexo, de mujeres exclusivamente heterosexuales. De manera que, a mayor exposición prenatal androgénica, mayor especificidad de la respuesta sexual, lo que explicaría la respuesta sexual específica en hombres heterosexuales y homosexuales, así como en mujeres homosexuales, quienes habrían estado expuestas a mayores niveles de testosterona prenatal que las mujeres heterosexuales. Sin embargo, no existe hasta el momento evidencia empírica con algún marcador biológico directo o indirecto que haya puesto a prueba esta hipótesis.

El estudio de la relación entre la exposición prenatal a la testosterona y las preferencias sexuales atípicas, como la pedofilia, utilizando la proporción 2D:4D como indicador hormonal indirecto, se justifica en la asociación de este marcador con diversos rasgos psicológicos dependientes del sexo, entre ellos, agresión y dominancia (van der Meij, Almela, Buunk, Dubbs, & Salvador, 2012), algunas habilidades cognitivas (Alexander & Son, 2007), el establecimiento y mantenimiento de relaciones de pareja a corto y largo plazo (Schwarz, Mustafić, Hassebrauck, & Jörg, 2011), la elección de características sexualmente atractivas (Ferdenzi, Lemaitre, Leongomez, & Roberts, 2011) y la orientación sexual (Lippa, 2003; Manning, Churchill, & Peters, 2007; Rahman, 2005). No obstante, los resultados sobre estas asociaciones han sido mixtos, por lo que se requiere mayor investigación al respecto.

En el caso de la pedofilia otros marcadores biológicos como la lateralidad manual han mostrado posibles efectos de la exposición prenatal sobre intereses sexuales pedófilos. Dado que la testosterona prenatal afecta la lateralidad, algunos estudios (Blanchard et al., 2007; Fazio, Lykins, & Cantor, 2014; Rahman & Symeonides, 2008) han encontrado que la lateralidad zurda se ha asociado con mayor frecuencia de pedofilia, sugiriendo que inestabilidades en el desarrollo causadas por la exposición prenatal androgénica podrían jugar un papel relevante en las preferencias sexuales desviadas en hombres, por lo que los investigadores podrían también abordar la hipótesis organizacional-activacional utilizando como marcador la proporción 2D:4D.

1.4.2 Factores epigenéticos y eventos vitales

Factores genéticos y hereditarios que modifican la expresión genética podrían ser la causa de preferencias sexuales hacia el mismo sexo o preferencias sexuales desviadas, aunque hay escasa evidencia al respecto. Estudios en gemelos han encontrado evidencia que sugiere que puede existir un componente genético y hereditario en la orientación sexual (Långström, Rahman, Carlström, & Lichtenstein, 2010; Mustanski et al., 2005) y, más recientemente, otros estudios han encontrado un pequeño componente hereditario en las preferencias sexuales desviadas hacia los niños (Alanko et al., 2010; Alanko, Salo, Mokros, & Santtila, 2013); sin embargo, el porcentaje de varianza explicada por este componente es muy bajo, por lo que los autores consideran necesario integrar en la explicación, los factores ambientales y del desarrollo temprano.

La epigenética se considera una forma útil de explicar la interacción entre la genética y el ambiente celular. De esta manera, alteraciones genéticas propiciadas por factores ambientales tempranos, generan efectos transitorios o permanentes que impactan las vías genéticas y la organización cerebral durante el desarrollo, que puede ser normal

o anormal. Esta organización emergente puede afectar el fenotipo animal en etapas del desarrollo más tardías, lo que llevaría a presumir que mecanismos epigenéticos, más que hereditarios, determinados por ejemplo por la influencia hormonal temprana, podrían contribuir al desarrollo de las preferencias sexuales humanas típicas y atípicas; sin embargo, actualmente no hay evidencia empírica que apoye esta hipótesis (Arnold, Chen, & Itoh, 2013; Tenbergen et al., 2015).

1.4.3 Factores del aprendizaje y eventos vitales

Las circunstancias sociales y culturales potencialmente adversas y los eventos personales y entornos físicos a los que la persona se expone a lo largo de la vida, pueden contribuir a vulnerabilidades psicológicas y formación de esquemas cognitivos distorsionados que llevan a conductas desadaptativas (Mann & Beech, 2003; Ward & Beech, 2006). Los desafíos ambientales, como los abusos sexuales en la infancia o la exposición temprana a experiencias sexuales (Beitchman et al., 1992), a los que pudo haberse tenido que enfrentar el individuo pueden llevar a la formación de distorsiones cognitivas acerca del sexo, alteraciones en el funcionamiento sexual, confusión en la identidad sexual, necesidad de reafirmar la masculinidad y a responder con abuso o agresión sexual en el futuro. Así, como afirman Ward y Beech (2006), los delitos sexuales son producto de una red de relaciones entre los individuos, sus hábitats y nichos locales.

1.4.4 Desequilibrios neuroquímicos

Déficits regulatorios en neurotrasmisores (NTs) como la Serotonina (5HT), norepinefrina (NE) y dopamina (DA) se han relacionado con el origen de las parafilias (Ward & Beech, 2006). Dado que el sistema de atracción sexual en los humanos involucra estos NTs, se ha hipotetizado un desequilibrio en la actividad de receptores 5HT asociado

con disminución de actividad pre-sináptica serotoninérgica y una hiperactividad de receptores post-sinápticos 5-HT2 (Maes, 2001). Así mismo, se ha sugerido un incremento de la excitación sexual ligada con alta actividad dopaminérgica; sin embargo, la investigación en este campo aún es escasa y estos desajustes químicos se relacionan no sólo con parafilias, sino también con otros desórdenes de control de impulsos y trastornos del estado de ánimo (Ward & Beech, 2006), por lo que su papel en las desviaciones sexuales no está claro (Tenbergen et al., 2015).

1.4.5 Alteraciones anatómicas y funcionales cerebrales

A nivel neurobiológico se han descrito alteraciones estructurales cerebrales, como reducción del volumen de la amígdala y el hipotálamo en pedófilos y abusadores sexuales de niños, y, a nivel funcional, decremento de la actividad prefrontal e inhibición temporal, así como alteraciones neuropsicológicas (Snowden et al., 2011). Estas últimas podrían ser generales, como baja capacidad intelectual, alta frecuencia de lateralidad zurda, bajos niveles de rendimiento académico y baja capacidad de esfuerzo, y específicas, como baja fluidez verbal, déficits en memoria de trabajo espacial y verbal, déficits en reconocimiento emocional y empatía y bajo funcionamiento ejecutivo (Tenbergen et al., 2015).

Cantor et al. (2008) resumen las principales teorías neuroanatómicas de la pedofilia en tres categorías:

1) Teorías de la disfunción frontal, que explican los déficits en control inhibitorio en los abusadores de niños y que se apoyan en hallazgos de diferencias en el tamaño de la corteza prefrontal dorsolateral derecha y orbitofrontal dorsolateral, en pedófilos con antecedentes de contacto sexual (Schiffer et al., 2007; Tenbergen et al., 2015) y en

hallazgos neuropsicológicos asociados con pobre rendimiento en tests de funcionamiento ejecutivo (Eastvold, Suchy, & Strassberg, 2011; Schiffer & Vonlaufen, 2011; Suchy, Eastvold, Strassberg, & Franchow, 2014). Sin embargo, estos hallazgos parecen explicar el comportamiento sexual desinhibido, pero no las preferencias sexuales pedófilas propiamente.

2) Teorías temporales límbicas: explican el comportamiento sexual desviado basado en alteraciones del funcionamiento del lóbulo temporal y del hipocampo (Ponseti, 2012). Sin embargo, no han sido suficientes para explicar las preferencias sexuales pedófilas, más allá del comportamiento sexual desinhibido similar al observado en el síndrome de Klüver-Bucy (Lilly, Cummings, Benson, & Frankel, 1983).

3) Teorías de disfunción dual: explican las desviaciones sexuales hacia los niños a partir de casos en los que se han encontrado disfunciones mixtas, frontales y temporales, llevando a comportamientos desinhibidos y urgencias sexuales descontroladas respectivamente (Cohen et al., 2002). Según Tenbergen (2015), los lóbulos frontal y temporal en estas teorías explican la expresión de la preferencia sexual pedófila y sus comportamientos asociados. De manera que el lóbulo frontal (corteza orbitofrontal y dorsolateral prefrontal) tendría un papel relevante en el bajo control inhibitorio en la comisión de delitos sexuales contra niños y el lóbulo temporal izquierdo (amígdala e hipocampo), sería predominante en la explicación de la urgencia y preocupación sexual hacia niños (Poeppl et al., 2013). La disminución del volumen de la amígdala izquierda puede ser un factor distintivo entre pedófilos y abusadores sexuales de niños no pedófilos, y parece reflejar una anormalidad pre-existente posiblemente proveniente de perturbaciones del neurodesarrollo temprano que afectan la organización cerebral y los circuitos responsables de las preferencias sexuales, hipótesis previamente apoyada en

alteraciones neuropsicológicas y tasa de lateralidad no-diestra entre pedófilos (Blanchard et al., 2007; Cantor et al., 2004; Fazio et al., 2014).

Recientemente se ha hipotetizado que la especificidad de la respuesta sexual masculina y la prevalencia de pedofilia entre hombres y no en mujeres, puede estar asociada a mecanismos neurobiológicos diferenciales responsables de las preferencias sexuales. Poeppl, Langguth, Rupprecht, Laird, y Eickhoff (2016) identificaron un circuito de la preferencia sexual, en el que no sólo existiría un mecanismo responsable de la activación sexual frente a estímulos sexuales relevantes (área preóptica y anterior del hipotálamo, tálamo anterior y medial-dorsal, área septal y peririnal del parahipocampo) compartida por hombres y mujeres, sino también un mecanismo inhibitorio, responsable de inhibir la respuesta sexual hacia estímulos sexuales irrelevantes, como es el caso de los niños. Esta inhibición frente a la no preferencia sexual estaría dada por la activación de la sustancia innominada, al parecer un área responsable de inhibir una respuesta frente a estímulos normalmente aversivos sexualmente y que se activa en hombres, pero no en mujeres cuando observan estímulos sexuales irrelevantes. Estos hallazgos podrían contribuir a la explicación de la ausencia de especificidad de la respuesta sexual femenina, en la que se evidencia un patrón de respuesta menos focalizado hacia el estímulo preferido sexualmente y de la vulnerabilidad masculina a desviaciones sexuales como la pedofilia, posiblemente dada por factores del neurodesarrollo asociados con la androgenización prenatal y la organización cerebral emergente que, bajo circunstancias adversas durante la gestación, podrían llevar a perturbaciones en el desarrollo y funcionamiento del mecanismo inhibitorio de la preferencia sexual hacia estímulos no relevantes sexualmente. No obstante, en la actualidad no hay evidencia suficiente disponible para apoyar esta hipótesis.

En conclusión, la pedofilia podría considerarse un trastorno del neurodesarrollo caracterizado por predominio de lateralidad no-diestra, baja estatura, menor capacidad intelectual, perturbación prenatal androgénica y disfunciones químicas y anatomo-funcionales. Sin embargo, no existe una causa establecida, ni dirección clara de la relación entre agresión sexual, pedofilia y pornografía infantil (Becerra García, 2009; Tenbergen et al., 2015).

1.5 Medidas de las preferencias sexuales típicas y atípicas

La metodología experimental cognitiva y los hallazgos neurocientíficos han empezado a cerrar la brecha entre el conocimiento de la fisiología de la respuesta sexual y la experiencia subjetiva de la excitación sexual (de Jong, 2009), a través del desarrollo de medidas indirectas de las cogniciones que subyacen a la respuesta sexual y que ponen a prueba los modelos explicativos de los procesos cognitivos que soportan las preferencias sexuales típicas y atípicas (Snowden et al., 2011)

Las preferencias sexuales han sido un tema sensible a lo largo del estudio de la sexualidad humana, no sólo por su construcción compleja y multifacética, sino por la influencia de la evaluación social en su definición y manifestación. Las declaraciones de preferencias sexuales no normativas, como la no heterosexualidad o de preferencias sexuales desviadas, como el interés sexual hacia los niños, pueden ser causa de rechazo o castigo en ciertos contextos sociales por lo que la mayoría de las veces buscan ser reprimidas y/u ocultadas. De allí que las medidas de autoinforme de las preferencias sexuales sean bastante criticadas por su validez (Rönspies et al., 2015).

La presentación de estímulos a través de la modalidad visual ha sido el método más utilizado para reemplazar o complementar las medidas de autoinforme de las preferencias sexuales. Por lo que casi toda la investigación sobre preferencias sexuales típicas y atípicas, se ha realizado con paradigmas de visualización de estímulos humanos seleccionados según la escala de madurez corporal de Tanner. La Escala Tanner (1962) permite indagar sobre las preferencias sexuales según la edad utilizando como indicador el esquema corporal. La escala describe cinco etapas de madurez del esquema corporal: Etapa I) pre-pubertad, carencia total de características secundarias sexuales; Etapa II) aparición de mamas y crecimiento testicular; Etapa III) Areola en mujeres y alargamiento del pene en hombres; etapa IV) aumento de pecho y crecimiento de areola en mujeres, inicio de la separación del tejido circundante en mamas y aumento de volumen testicular en hombres; Etapa V) plena madurez, separación total de mamas en mujeres , completo crecimiento de pene en hombres, oscurecimiento escroto, vello púbico total cobertura en ambos géneros (Seto, 2008; Tenbergen et al., 2015). Esta escala sigue siendo muy usada en investigaciones sobre las preferencias sexuales según la edad (Attard-Johnson, Bindemann, & Ó Ciardha, 2016; Fromberger, Jordan, von Herder, et al., 2012; Jordan et al., 2017) y en la evaluación clínica de intereses sexuales pedófilos (Fromberger et al., 2013; Jordan et al., 2016; Mokros, Dombert, Osterheider, Zappala, & Santtila, 2010; Ó Ciardha & Gormley, 2012).

1.5.1 Medidas Directas vs Indirectas

Actualmente, las medidas de las preferencias sexuales pueden ser clasificadas en dos grandes grupos, directas e indirectas. Según Snowden et al (2011), las medidas de la cognición subyacente a las preferencias sexuales son directas cuando la respuesta es

tomada como un indicador del atributo de interés (ej. homosexualidad, pedofilia, etc.); estas medidas pueden ser autoreportes explícitos acerca de las preferencias sexuales del individuo evaluado o registros de excitación genital medida a través de pletismografía vaginal o peneana, que mide los cambios del arousal genital a partir de la presentación de estímulos sexuales y se basan en cambios relativos del volumen sanguíneo del pene o la vagina (Tenbergen et al., 2015). Este ha sido el principal método de evaluación de agresores sexuales de niños; en él, se expone a los sujetos a estímulos auditivos o visuales que involucran niños y mujeres adultas mientras se miden los cambios en la circunferencia del pene. El test falométrico, como también se conoce, es altamente efectivo en la identificación de intereses sexuales hacia los niños, sin embargo, desafortunadamente en muchos casos es inviable por diversas razones, costos, tiempo, y respuestas de excitación no significativas para extraer conclusiones (Snowden et al., 2011).

En las medidas indirectas, la respuesta no es un indicador del atributo en cuestión, si no que el atributo es inferido por el investigador a partir de otra respuesta no relacionada con el atributo. Estas respuestas permiten acceder de manera indirecta y en diferentes niveles de consciencia a la cognición del evaluado. Según el nivel de consciencia sobre el atributo que se produce en el individuo cuando es evaluado, pueden clasificarse en dos tipos de medidas, explícitas, aquellas que elicitan respuestas más controladas por el sujeto y que permiten la reflexión frente al atributo, y medidas implícitas, aquellas que elicitan respuestas automáticas, que hacen menos conscientes las cogniciones generadas por la técnica y por tanto son menos manipulables (Snowden et al., 2011).

A partir de los inconvenientes de las medidas directas de auto-reporte, por su baja confiabilidad por la influencia de la deseabilidad social en el sujeto evaluado y de las medidas genitales, por ser invasivas y de alto costo (Chivers et al., 2010), y con la

necesidad de desarrollar métodos difíciles de falsificar o al menos que no requieran equipo de supervisión adicional (Dombert et al., 2017), la investigación actual se ha enfocado en el desarrollo de medidas indirectas de las preferencias sexuales típicas y atípicas utilizando paradigmas atencionales, ya sea a través de la medición de respuestas fisiológicas (movimientos oculares o dilatación pupilar) o a través de respuestas conductuales (tiempo de respuesta o tiempo de visualización), dada su practicidad y bajo costo (Rönspies et al., 2015).

Medidas indirectas a partir de respuestas conductuales

Dentro de las medidas indirectas utilizando respuestas conductuales (especialmente en el estudio de preferencias sexuales atípicas como el interés sexual hacia los niños) se pueden citar aquellas basadas en la *latencia de respuesta*, como el Test de asociación implícita o IAT por sus siglas en inglés (Implicit Association Test) (Babchishin, Nunes, & Hermann, 2013; Rönspies et al., 2015); el paradigma de Evaluación Relacional Implícito o IRAP (Relational Assessment Procedure; Rönspies et al., 2015; Implicit Vahey, Nicholson, & Barnes-Holmes, 2015), la Tarea de Stroop modificada (Ó Ciardha & Gormley, 2012), el paradigma de Presentación Visual Serial Rápida (RSVP, por su siglas en inglés; Flak, Beech, & Humphreys, 2009), entre otros. Su objetivo es identificar preferencias sexuales a partir de la rapidez o retraso en la respuesta a partir de la visualización explícita (estímulo objetivo) o implícita (estímulo distractor) de estímulos relevantes (sexo preferido) y no relevantes sexualmente (ej. adulto del sexo no preferido o niños).

En tareas en las que se mide la correspondencia entre el estímulo y la respuesta y en las cuales el estímulo sexual debe ser atendido (explícito), como el IAT o el IRAP, se ha evidenciado que existe una menor latencia de respuesta, si existe una congruencia entre

el estímulo preferido sexualmente y el contenido de una cognición (ej. menor latencia de respuesta en hombres homosexuales cuando se presenta una asociación incongruente entre la imagen de un hombre adulto y la frase "sexualmente atractivo" al mismo tiempo, que cuando se presenta una asociación congruente entre la imagen de una mujer adulta y la palabra "sexualmente atractiva"; Rönspies et al., 2015). Así, estos paradigmas permiten identificar asociaciones atípicas entre los estímulos y las cogniciones, por ejemplo, en el caso de los niños y el sexo en agresores sexuales de niños.

En tareas en las que se mide también la correspondencia entre el estímulo y la respuesta, pero en las que el estímulo relevante sexualmente debe ser ignorado, como en el RSVP o el test de Stroop modificado, existe mayor latencia de respuesta cuando el estímulo preferido sexualmente es el distractor (ej. mayor latencia de respuesta en hombres heterosexuales en la nominación de un color cuando de fondo se presenta el cuerpo semidesnudo de una mujer que cuando se presenta de fondo el cuerpo semidesnudo de una niña en el test de Stroop modificado; Ó Ciardha & Gormley, 2012). En contraste, en hombres abusadores sexuales de niños se observa el patrón opuesto, menores latencias en IAT (Hempel, Buck, Goethals, & van Marle, 2013) y en IRAP (Dawson, Barnes-Holmes, Gresswell, Hart, & Gore, 2009) y mayores latencias de respuesta en Stroop (Ó Ciardha & Gormley, 2012) y en RSVP (Flak et al., 2009) en presencia de estímulos infantiles.

Los paradigmas basados en respuestas conductuales, pero según *el tiempo de visualización* de los participantes, son tareas en las que se pide al sujeto que califique una imagen según un atributo, normalmente el atractivo del individuo presentado, mientras que se realiza la grabación del tiempo que le toma responder. El tiempo de respuesta es la medición implícita de la preferencia sexual (Ó Ciardha & Gormley, 2012). Con este paradigma se ha encontrado evidencia de que tanto hombres con preferencias

heterosexuales (Rönspies et al., 2015) como hombres y mujeres homosexuales (Rullo, Strassberg, & Israel, 2010), invierten más tiempo mirando estímulos del sexo preferido reportado, que estímulos del sexo no preferido.

En evaluación de abusadores sexuales de niños se han reportado diferencias con hombres no abusadores, encontrándose que abusadores sexuales de niños observan significativamente más tiempo imágenes de niños mientras evalúan su atractivo, comparado con los no abusadores (Babchishin, Nunes, & Kessous, 2014; Mokros et al., 2013).

Existen diversos métodos y variaciones orientadas a la identificación de agresores sexuales de niños e intereses sexuales pedófilos. Sin embargo, la investigación requiere replicabilidad de preguntas de investigación, grupos, técnicas y tipos de estímulos para lograr establecer la verdadera utilidad y confiabilidad de una técnica en la identificación de preferencias sexuales y especialmente de agresores sexuales. Se reportan múltiples tamaños de efecto en los diferentes estudios que, por sus variaciones metodológicas, son difícilmente comparables, por lo que se está aún muy lejos de establecer cuál es la mejor medida indirecta de intereses sexuales. Así mismo, algunos estudios presentan como limitación el uso de índices absolutos de las asociaciones distorsionadas o no normativas entre los participantes, lo cual es inapropiado, ya que estas asociaciones pueden estar influidas por múltiples factores, como por ejemplo, personas con historia de victimización sexual en la infancia, que podrían tener índices altos de asociaciones incongruentes entre niños y sexo, y no necesariamente tener intereses sexuales pedófilos. Por ello en este tipo de técnicas se sugiere el uso de índices relativos (Snowden et al., 2011)

Medidas Indirectas a partir de respuestas fisiológicas

El rastreo ocular y la pupilometría son técnicas de evaluación de respuestas fisiológicas asociadas con estímulos sexuales relevantes que se llevan a cabo a través de equipos de rastreo ocular o *eye trackers*. Estas técnicas se han aplicado recientemente para la evaluación de las preferencias sexuales según el sexo y la edad de los estímulos, con el interés no sólo de explorar respuestas oculares automáticas y controladas hacia los estímulos típicamente preferidos (adultos) (Attard-Johnson et al., 2016; Fromberger, Jordan, von Herder, et al., 2012), sino también otras hacia estímulos atípicamente preferidos en desviaciones sexuales como la pedofilia y el abuso sexual infantil (Attard et al., 2016; Fromberger et al., 2013; Fromberger, Jordan, Steinkrauss, et al., 2012).

A través de la técnica de pupilometría se busca explorar si el aumento del tamaño de la pupila proporciona un índice específico de interés sexual hacia los estímulos preferidos. La evidencia reciente ha demostrado que la dilatación pupilar puede ser un índice específico de preferencias sexuales de hombres ginéfilos y andrófilos según la edad y el sexo de los estímulos, ya que los estímulos adultos del sexo preferido elicitan una mayor respuesta pupilar que los estímulos adultos del sexo no preferido y niños. Sin embargo en mujeres es un índice específico de preferencia sexual según la edad, pero no según el sexo, ya que se evidencia una mayor dilatación pupilar independiente del sexo hacia estímulos adultos que hacía estímulos infantiles (Attard-Johnson et al., 2016; Attard-Johnson, Bindemann, & Ó Ciardha, 2017; Attard et al., 2016). Hasta el momento, no se han realizado estudios con abusadores sexuales de niños que permitan evidenciar la utilidad del índice en grupos forenses.

Mientras que la pupilometría usa la dilatación pupilar, el rastreo ocular utiliza las fijaciones para medir de forma indirecta los intereses sexuales, basados en el modelo del

procesamiento de la información del arousal sexual que se ha revisado previamente (Janssen, Everaerd, Spiering, & Janssen, 2000). Este modelo asume que el foco atencional de una persona se desplaza automáticamente hacia un objeto que es interesante y se mantiene si las características del estímulo coinciden con las almacenadas en la memoria explícita produciendo una respuesta sexual consciente (Dombert et al., 2017; Fromberger, Jordan, von Herder, et al., 2012), por lo que la interacción entre procesos cognitivos de atención temprana o pre-atencionales y de atención tardía, podría ser indicador de la activación sexual ligada con las preferencias sexuales típicas y atípicas.

1.5.1.1.1 Técnica de Rastreo ocular y parámetros de medición

La tecnología de los rastreadores oculares viene usándose desde hace largo tiempo en diversos campos de investigación acerca de la percepción de escenas (Henderson, Brockmole, Castelhano, & Mack, 2007; Henderson, Weeks, Phillip, & Hollingworth, 1999) y en el ámbito clínico (Armstrong & Olatunji, 2012; Holzman, 1974). Es una medida fisiológica somática del comportamiento ocular que permite tener acceso a los procesos atencionales del individuo y, de forma indirecta a sus cogniciones.

La mirada y los movimientos oculares tienen sin duda una función relevante en la comprensión de la conducta humana a nivel cognitivo, emocional y social (Duchowski, 2017; Itier & Batty, 2009). La teoría de acoplamiento funcional plantea que las intenciones específicas de una persona, dirigidas a una meta, se encuentran acopladas al procesamiento visual selectivo (Bolmont, Cacioppo, & Cacioppo, 2014). Según Land (2006), los movimientos de los ojos rara vez se dirigen a lugares irrelevantes para la acción o meta del individuo sino que, por el contrario, son claves para organizar nuestras acciones y ayudan a recoger información para iniciar la ejecución, por tanto, dan información relevante acerca de nuestras intenciones, preferencias y planes de acción.

La mirada tiene importantes funciones sociales, de manera que, además de permitir obtener información de los estímulos observados, permite que el sujeto dirija su atención hacia los objetos o personas, según las demandas del entorno. Así mismo, realizar el seguimiento a la mirada de otros, nos ofrece acceso a aquello que constituye su foco de atención y que resulta fundamental para comprender sus estados mentales. De ahí que la mirada sea uno de los objetos de estudio más abordados dentro de la comprensión del cerebro social (Pfeiffer, Vogeley, & Schilbach, 2013).

En 1967, Yarbus demostró que los movimientos oculares siguen un patrón de exploración secuencial que se distribuye por regiones específicas de la imagen según la información requerida por el observador. De esta manera, Yarbus comprobó que los movimientos oculares no se relacionan en función de la estructura de la imagen, solamente, sino que están dados por un proceso de arriba-abajo comandado por el cerebro a nivel cortical ejecutivo. Así, cuando se realiza una acción o plan de acciones, surgen preguntas que sólo pueden ser respondidas haciendo los movimientos oculares precisos. De esta manera, se rompió con la idea de que los movimientos oculares eran acciones reflejas y se demostró que tienen una función más estratégica (Duchowski, 2017; Land, 2006).

Comprender el funcionamiento del sistema visual es clave para entender cómo se conectan los movimientos oculares con la percepción y atención visual, como procesos cognitivos básicos que son clave para el acceso a procesos más complejos a nivel cognitivo y afectivo. Los movimientos oculares se clasifican de manera general en dos tipos, sacádicos y fijaciones. Los movimientos sacádicos son movimientos rápidos que funcionan para redirigir los ojos a nuevas partes del entorno, mientras que las fijaciones son intervalos entre movimientos sacádicos en los cuales la mirada se mantiene en un

punto, allí donde se obtiene información de la escena (Henderson et al., 1999; Land, 2006).

Las fijaciones son la unidad de análisis en el rastreo ocular. El sistema visual humano hace un fino escrutinio del foco de fijación a través de breves fijaciones sobre áreas específicas de interés. La fóvea es el área de la retina responsable de esta capacidad de percibir en detalle. La visión central foveal ocurre gracias a la reflexión corneal que proyecta la luz en el fondo ocular permitiendo una inspección fina de 0 a 5ºde todo el foco de entrada visual. El 90% del tiempo el ojo permanece en fijaciones, y sólo cuando el foco de atención cambia los movimientos oculares sacádicos reposicionan la fóvea hacia el nuevo foco de interés. El sistema visual funciona a través de las conexiones entre la retina y las regiones específicas del cerebro, las llamadas vías visuales (Duchowski, 2017).

Los rastreadores oculares funcionan a partir de la reflexión corneal, permitiendo que una luz infrarroja atraviese el ojo y sea dirigida por la córnea a la retina, específicamente a la fóvea. La reflexión corneal es una de 4 imágenes reflejadas en las 4 superficies del ojo. Estas se denominan imágenes de Purkinje. El Eye tracker o rastreador ocular trabaja con la imagen 1 y el centro pupilar. Una cámara fotosensible recibe las señales luminosas reflejadas a través de la pupila, y las dirige a la unidad central del *eye tracker*, el cual se encarga de computar algorítmicamente la posición relativa entre el punto de reflexión corneal y el centro pupilar, permitiendo determinar con precisión la fijación del ojo. Al estar asociada con la abertura pupilar, este mismo proceso se lleva a cabo en las técnicas de pupilometría (Cabestrero, Conde-Guzón, Crespo, Grzib, & Quirós, 2005).

A nivel neurofisiológico, las estructuras y vías que participan en la percepción y atención visual y que permiten relacionar el cerebro con el ojo y sus movimientos son: los colículos superiores, importantes para la realización de los movimientos oculares; el área visual primaria, responsable de la detección de los estímulos; las áreas V2, V3, y V4, dedicadas a la percepción de movimiento y color; área V5, área medial temporal y temporal superior, procesan señales de movimiento y controlan movimientos oculares suaves; y el complejo parietal posterior, involucrado en la realización de las fijaciones. Así mismo, existen dos vías responsables de la percepción y atención visual que conectan con el área V1, que se denominan dorsal y ventral. La vía ventral, se encarga del procesamiento sensoriomotor, es decir, el dónde atencional (localización y movimientos), mientras que la vía dorsal, se encarga del procesamiento cognitivo, es decir, el qué atencional (Duchowski, 2017).

El seguimiento ocular y la dilatación de la pupila también pueden indicar preferencia sexual, y, como se vió anteriormente, la evidencia muestra que los hombres reaccionan más fuertemente (especificidad de la respuesta sexual) que las mujeres a estímulos sexuales preferidos (Tenbergen et al., 2015), y esta reacción incluye las fijaciones producto de procesos atencionales tempranos y tardíos elicitados por los estímulos relevantes sexualmente.

La atención temprana es un proceso de atención exógena de tipo *bottom up*, en el que un estímulo distractor captura la atención del sujeto de forma preconsciente e interrumpe su atención endógena, es decir, controlada, hacia un foco atencional que el sujeto ha decidido o ha sido instruido para atender. En medidas indirectas de respuestas conductuales en donde se debe ignorar el estímulo sexual relevante, el tiempo de reacción es un índice de atención exógena que permite medir cuanto un estímulo distractor, que suele ser el de interés en el estudio, captura la atención del individuo. En las medidas

indirectas de respuestas fisiológicas, otro índice de atención exógena son los movimientos oculares; las sacadas son alteradas a medida que aparece un distractor, por lo que el tiempo que transcurre entre una sacada y otra, es decir, la latencia de la primera fijación y el número de primeras fijaciones hacia estímulos de determinada categoría, son indicadores de captura atencional temprana del estímulo o de sus características relevantes. Se ha encontrado que las redes de atención dorsal y ventral son circuitos claves subyacentes a aspectos de la atención exógena (Carretié, 2014). Para medir los procesos atencionales tempranos es importante tener presente en la escena más de dos estímulos que compitan entre sí por los recursos atencionales del individuo, por lo que la atención hacia un estímulo dependerá en gran medida de los estímulos con los que se encuentre en competencia (Fromberger, Jordan, von Herder, et al., 2012; Nummenmaa, Hyönä, & Calvo, 2006).

Por otro lado, la atención tardía es un proceso de atención endógena, controlado de tipo *top down,* en el que se procesan de forma consciente las características relevantes de los estímulos cuando estos son de mayor interés o cuando ofrecen mayor cantidad de información relevante, por lo que se pasa más tiempo explorando regiones de los estímulos que capturan más el interés o que son preferidos (Henderson et al., 1999). Las fijaciones duran entre 200 y 300 ms, periodo suficientemente estable como para obtener y procesar información. La cantidad de tiempo que una persona invierte mirando un área de interés particular se mide utilizando como parámetro de medición el tiempo total de fijación o duración de fijaciones, el cual correlaciona normalmente con la cantidad o número de fijaciones sobre un área de interés (Wenzlaff, Briken, & Dekker, 2016).

Aunque ambos procesos atencionales y sus parámetros de medición ofrecen valiosa información acerca de las preferencias e intereses de los individuos, la duración total de fijaciones es más fácilmente manipulable que la latencia de fijación o las primeras

fijaciones, relacionadas con los procesos atencionales tempranos pre-conscientes (Spiering & Everaerd, 2007; Wenzlaff et al., 2016).

Aunque la metodología de *eye tracking* basada en la visualización de estímulos se ha venido usando en las últimas décadas en la investigación sexual (Dawson & Chivers, 2016; Krupp, 2008; Lykins et al., 2006; Rupp & Wallen, 2007), existe escasa evidencia utilizando esta metodología en el estudio de la cognición de delincuentes sexuales. Sólo un grupo de investigación en Alemania, liderado por Fromberger, ha evaluado la utilidad de la técnica entre agresores sexuales con intereses sexuales hacia los niños (Fromberger et al., 2013; Fromberger, Jordan, Steinkrauss, et al., 2012; Jordan et al., 2016). Los resultados acerca de los sesgos atencionales tempranos y tardíos presentes en agresores sexuales de niños han sido mixtos (Fromberger et al., 2013; Fromberger, Jordan, Steinkrauss, et al., 2012), de manera que no es claro si ambos indicadores discriminan entre agresores sexuales de niños, otro tipo de agresores sexuales y no sexuales, así como no agresores, o sólo la atención temprana sería un buen indicador al ser menos manipulable conscientemente.

A partir de la revisión teórico-empírica presentada en este capítulo se plantearon diversas hipótesis en relación con la identificación de preferencias sexuales típicas (homosexuales – heterosexuales) y preferencias sexuales atípicas que llevan a conductas sexuales desviadas (abuso sexual infantil) utilizando la metodología de rastreo ocular que se desarrollarán en el siguiente apartado y que fundamentan la presente tesis.

CAPÍTULO 2. OBJETIVOS E HIPÓTESIS

La presente tesis doctoral tuvo como objetivo principal analizar las posibles diferencias en el patrón de atención visual temprano y tardío entre hombres y mujeres con preferencias sexuales típicas, ginéfilas y andrófilas, y atípicas desviadas, como el abuso sexual infantil y la pedofilia, según la edad y el sexo de los estímulos, utilizando la metodología de rastreo ocular.

Objetivo general 1. Evaluar la especificidad de la respuesta sexual de hombres y mujeres, ginéfilos y andrófilos, hacia estímulos que varían según el sexo y la edad, a través de la medición de procesos de atención temprana y tardía usando la técnica de rastreo ocular.

- ***Objetivo específico 1.1.*** Evaluar el efecto del sexo de los estímulos sobre los procesos de atención temprana de hombres y mujeres ginéfilos y andrófilos.
    - ***Hipótesis 1.1.*** El tiempo para la primera fijación será más corto sobre los estímulos del sexo preferido, de forma consistente con la orientación sexual de los participantes.
- ***Objetivo específico 1.2.*** Evaluar el efecto del sexo de los estímulos sobre los procesos de atención tardía de hombres y mujeres ginéfilos y andrófilos.
    - Hipótesis 1.2. La duración total de las fijaciones será mayor sobre los estímulos del sexo preferido, de forma consistente con la orientación sexual de los participantes.
- ***Objetivo específico 1.3.*** Evaluar el efecto de la edad de los estímulos sobre los procesos de atención temprana de hombres y mujeres ginéfilos y andrófilos.

  - ***Hipótesis 1.3.*** El tiempo para la primera fijación será más corto sobre los estímulos preferidos adultos que sobre los estímulos infantiles, de forma consistente con la orientación según la edad de los estímulos sexuales preferidos reportada por los participantes.

- ***Objetivo específico 1.4.*** Evaluar el efecto de la edad de los estímulos sobre los procesos de atención tardía de hombres y mujeres ginéfilos y andrófilos.
  - ***Hipótesis 1.4.*** La duración total de las fijaciones será mayor sobre los estímulos preferidos adultos que sobre los estímulos infantiles, consistente con la orientación según la edad de los estímulos sexuales preferidos reportada por los participantes.
- ***Objetivo específico 1.5.*** Evaluar la inespecificidad de la respuesta sexual de mujeres andrófilas según el sexo de los estímulos.
  - ***Hipótesis 1.5.1.*** Mujeres andrófilas mostrarán tiempos para la primera fijación similares hacia estímulos de ambos sexos, mientras que mujeres ginéfilas y hombres andrófilos y ginéfilos, mostrarán tiempos de fijación más cortos hacia estímulos adultos del sexo preferido.
  - ***Hipótesis 1.5.2.*** Mujeres andrófilas mostrarán duración total de fijaciones similares hacia estímulos de ambos sexos, mientras que mujeres ginéfilas y hombres andrófilos y ginéfilos, mostrarán duración total de fijaciones más larga hacia estímulos adultos del sexo preferido.
- ***Objetivo específico 1.6***. Determinar las áreas específicas del cuerpo (rostro, pecho y pelvis) de los estímulos preferidos que capturan más rápido y durante más tiempo la atención de hombres y mujeres ginéfilos y andrófilos.
  - ***Hipótesis 1.6.1.*** El tiempo para la primera fijación será más corto hacia todas las áreas específicas de interés del estímulo adulto sexualmente preferido.

- ***Hipótesis 1.6.2.*** La duración total de fijaciones será más larga hacia todas las áreas específicas de interés del estímulo adulto sexualmente preferido.

Objetivo general 2. Explorar la relación entre la proporción 2D:4D como indicador de exposición prenatal androgénica, y los procesos de atención temprana y tardía hacia estímulos sexualmente preferidos usando la técnica de rastreo ocular en hombres y mujeres ginéfilos y andrófilos:

- ***Objetivo específico 2.1.*** Establecer diferencias entre la proporción 2D:4D entre hombres y mujeres andrófilos y ginéfilos.
  - ***Hipótesis 2.1.1.*** Según el sexo de los participantes, los hombres presentarán proporción 2D:4D más bajas que las mujeres.
  - ***Hipótesis 2.1.2.*** Según las preferencias sexuales de los participantes, hombres y mujeres ginéfilos presentarán proporciones 2D:4D más bajas que hombres y mujeres andrófilos.
- ***Objetivo específico 2.2.*** Estudiar la relación entre la proporción 2D:4D y la atención temprana hacia estímulos adultos preferidos sexualmente.
  - ***Hipótesis 2.2.*** Hombres y mujeres de cualquier orientación sexual con bajas proporciones 2D:4D (más masculinizadas) mostrarán tiempos para la primera fijación más cortos sobre cuerpos, y especialmente áreas sexuales (rostro, pecho y pelvis), de sus estímulos sexualmente preferidos, que hombres y mujeres con proporciones 2D:4D altas.
- ***Objetivo específico 2.3.*** Estudiar la relación entre la proporción 2D:4D y la atención tardía hacia estímulos adultos preferidos sexualmente.
  - ***Hipótesis 2.3.*** Hombres y mujeres de cualquier orientación sexual con bajas proporciones 2D:4D (más masculinizadas) mostrarán duración total de

fijaciones mayor sobre cuerpos, y especialmente áreas sexuales (rostro, pecho y pelvis), de sus estímulos sexualmente preferidos, que hombres y mujeres con proporciones 2D:4D altas.

Objetivo general 3. Comparar los patrones de atención temprana y tardía hacia estímulos sexualmente maduros (adultos) en competencia con estímulos sexualmente inmaduros (niños) entre cuatro grupos de hombres adultos: 1) condenados por abuso sexual contra niños; 2) condenados por agresión sexual contra adultos; 3) condenados por delitos no sexuales; 4) comunidad general sin antecedentes de delitos, utilizando la metodología de rastreo ocular.

- ***Objetivo específico 3.1.*** Establecer diferencias en atención temprana hacia estímulos sexualmente inmaduros en competencia con estímulos sexualmente maduros entre los cuatro grupos de estudio.
    - ***Hipótesis 3.1.1.*** Abusadores sexuales de niños mostrarán mayor número de primeras fijaciones hacia estímulos infantiles que los hombres condenados por agresión sexual hacia adultos, delitos no sexuales y comunidad general.
    - ***Hipótesis 3.1.2.*** Abusadores sexuales de niños mostrarán menor tiempo para la primera fijación hacia estímulos infantiles que los hombres condenados por agresión sexual hacia adultos, delitos no sexuales y comunidad general.
- ***Objetivo específico 3.2.*** Establecer diferencias en atención tardía hacia estímulos sexualmente inmaduros en competencia con estímulos sexualmente maduros entre los cuatro grupos de estudio.
    - ***Hipótesis 3.2.1.*** Abusadores sexuales de niños mostrarán mayor duración total de fijaciones hacia estímulos infantiles que los hombres condenados por agresión sexual hacia adultos, delitos no sexuales y comunidad general.

  - **Hipótesis 3.2.2.** Abusadores sexuales de niños mostrarán mayor cantidad total de fijaciones hacia estímulos infantiles que los hombres condenados por agresión sexual hacia adultos, delitos no sexuales y comunidad general.

- ***Objetivo específico 3.3.*** Determinar las áreas específicas del cuerpo (rostro, pecho y pelvis) de los estímulos infantiles que capturan más rápido y durante más tiempo la atención de abusadores sexuales de niños.
  - ***Hipótesis 3.3.1.*** Abusadores sexuales de niños mirarán durante mayor cantidad de tiempo áreas eróticas de estímulos infantiles, que los hombres condenados por agresión sexual hacia adultos, delitos no sexuales y comunidad general.
  - ***Hipótesis 3.3.2.*** Abusadores sexuales de niños mirarán mayor cantidad de veces áreas eróticas de estímulos infantiles, que los hombres condenados por agresión sexual hacia adultos, delitos no sexuales y comunidad general.

CAPÍTULO 3. ESTUDIO 1. VISUAL ATTENTION PATTERNS DIFFER IN GYNEPHILIC AND ANDROPHILIC MEN AND WOMEN DEPENDING ON AGE AND GENDER OF TARGETS

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3.1 Abstract

Visual attention patterns measured with eye-tracking techniques provide indirect clues about sexual response. This study aimed to test the category specificity of sexual responses to stimuli varying in gender and age by evaluating both early and late attention of gynephilic and androphilic men and women. We simultaneously presented sexually preferred and non-preferred stimuli and measured time to first fixation and total duration of fixation on four areas of interest: entire body, then face, chest, and pelvis. Androphilic women´s early attention patterns were nonspecific, whereas gynephilic women and both groups of men showed a category specific pattern for the entire body. In contrast, all groups showed gender-specific patterns of late attention for all areas of interest. We also found support for age-specificity of early and late visual attention in all four groups, with greater attention to adult than child stimuli. This study supports the usefulness of a competing stimulus eye-tracking paradigm as a method to examine gender-specificity in gynephilic women and androphilic and gynephilic men, and as a measure of age-specificity in gynephilic and androphilic men and women.

3.2 Introduction

The study of the correspondence between sexual preferences, such as sexual orientation for gender or for age (Seto, 2012, 2017), and sexual response patterns has commonly used paradigms based on the visual presentation of sexually preferred and non-preferred stimuli (Chivers, Seto, & Blanchard, 2007). Subjective, physiological, and indirect measurements – which do not always correlate with each other – have been used because sexual response has emotional, physiological, and cognitive components (Chivers et al., 2010; Dawson & Chivers, 2016; de Jong, 2009; Janssen, Everaerd, Spiering, & Janssen, 2000; Spiering & Everaerd, 2007). Subjective measurements are obtained through self-report, either concurrently or after stimulus presentation. Physiological measurements are most commonly obtained through recordings of changes in penile circumference or volume in men or through changes in vaginal wall blood engorgement in women. Indirect measures rely on cognitive processes and are popular because they do not depend on verbal reports, are non-invasive, and they can register different facets of sexual response; indirect measures include reaction time, pupillary dilation, initial gaze orientation, and total time of fixation (Attard-Johnson, Bindemann, & Ó Ciardha, 2016; Chivers et al., 2007; Rieger & Savin-Williams, 2012; Rieger, Savin-Williams, Chivers, & Bailey, 2016; Samson & Janssen, 2014).

Sexual responses to stimuli can be specific or non-specific. A sexual response is specific if there is a predominant response to a sexually preferred stimulus, and non-specific when there are similar responses to both preferred and non-preferred stimuli (Chivers et al., 2010). In *gynephilic* (female-preferring) and *androphilic* (male-preferring) men, both subjective and genital sexual response are specific to the preferred gender (Fromberger, Jordan, Steinkrauss, et al., 2012; Fromberger, Jordan, Von Herder, et al.,

2012; Hewig, Trippe, Hecht, Straube, & Miltner, 2008). In women, initial work suggested subjective sexual responses are gender-specific, whereas genital responses are nonspecific for gender (Chivers, Rieger, Latty, & Bailey, 2004). Subsequent research by Chivers and her colleagues suggested this effect was explained by exclusively androphilic women, because women with any gynephilic sexual interests showed gender specific genital responses (Bouchard, Timmers, & Chivers, 2015). Gender specificity can also be observed when presenting lower intensity stimuli, such as images of engorged genitals without the rest of the person, compared to higher intensity stimuli such as those depicting persons engaged in explicit sexual activity (Spape, Timmers, Yoon, Ponseti, & Chivers, 2014).

3.2.1 Model of Sexual Arousal

The model of sexual arousal of Janssen, Everaerd, Spiering, y Janssen (2000; Spiering & Everaerd, 2007) highlights the interaction between automatic and controlled attention processes in sexual arousal, where relevant sexual characteristics of a sexually preferred stimulus are first pre-consciously and then consciously processed, influencing the sexual response. Thus, visual attention processes are of great importance in understanding sexual arousal triggered by relevant sexual stimuli. Eye-tracking methods can be used to measure both automatic attention (time to first fixation, i.e., *early attention*), which provides information about the stimulus cues that attract the subject's attention fastest; and controlled attention (duration of fixation, i.e., *late attention*), which provides information about what cues are the most relevant (Fromberger, Jordan, Von Herder, et al., 2012; Hewig et al., 2008).

Eye tracking studies have shown gender specificity in both early and late attention toward sexually preferred stimuli in gynephilic men (Dixson, Grimshaw, Linklater, &

Dixson, 2011; Fromberger, Jordan, Von Herder, et al., 2012; Hall, Hogue, & Guo, 2011; Hewig et al., 2008). Furthermore, two studies found evidence of gender-specificity in late attention patterns in both gynephilic and androphilic men (Fromberger, Meyer, Kempf, Jordan, & Müller, 2015; Mitrovic, Tinio, & Leder, 2016). We have not found previous research studying early attention in androphilic men.

The evidence is different in women. Two studies have found gender non-specificity for early attention, but not late attention, in androphilic women (Dawson & Chivers, 2016; Hewig et al., 2008); androphilic women fixated longer, but not faster, on stimuli of their self-reported preferred gender (men). Another set of studies has only examined late attention, finding gender non-specificity in androphilic women, with similar responses towards both male and female stimuli (Lippa, Patterson, & Marelich, 2010; Lykins, Meana & Strauss, 2008; Rieger & Savin-Williams, 2012). Conversely, androphilic women have shown a specific late attentional pattern in some studies, but towards female stimuli (Hall et al., 2011; Rupp & Wallen, 2007).

In sum, studies examining sexual response to gender cues have found that gynephilic men, androphilic men, and gynephilic women show gender specificity (Chivers et al., 2007; Ebsworth & Lalumière, 2012; Mitrovic et al., 2016; Rieger et al., 2015, 2016; Rieger & Savin-Williams, 2012; Samson & Janssen, 2014). In addition, research on sexual age preferences have suggested that both men and women show age-specific visual attention. In other words, non-paedophilic men and women usually show much greater sexual response toward adults than toward children, as indicated by pupillary dilation or longer fixation time (Attard-Johnson et al., 2016; Ebsworth & Lalumière, 2012; Fromberger et al., 2013; Hall et al., 2011). However, a previous eye-tracking study found age specificity in men, but not in women (Hall et al., 2011). Early attention has been studied less in terms of stimulus age. Some studies (Fromberger et al.,

2013; Fromberger, Jordan, Steinkrauss, et al., 2012; Fromberger, Jordan, Von Herder, et al., 2012) have observed age specificity in men's early and late attention patterns, but only in gynephilic men; only Hall et al., (2011) observed non-specificity for late attention in androphilic women. To our knowledge, no studies have included both androphilic men and gynephilic women.

3.2.2 Focal Areas of Interest

Both early and late visual attention could be directed towards either erotic (chest, hips, genitals) or non-erotic (face, legs) parts of the figure (Lykins, Meana, & Kambe, 2006; Lykins et al., 2008). Some studies have shown that gynephilic men direct and maintain their attention toward women's face (Rupp & Wallen, 2007), chest, and hip-waist areas (Dixson et al., 2011; Hall et al., 2011; Hewig et al., 2008). Results are less consistent for androphilic women; some studies have found similar early and late attention toward both male and female faces and legs (Hewig et al., 2008), whereas others have reported increased attention to the chest and/or the waist-hip areas of other women (Hall et al., 2011), or the genital areas of either men or women (Rupp & Wallen, 2007). Regarding age, Fromberger et al. (Fromberger et al., 2013) found that the face and chest areas of adults attract the attention of gynephilic, non-paedophilic men faster and for a longer time than children's faces or genitals. However, there is no evidence about the regional interests of women or androphilic men.

3.2.3 The Present Study

In the present study, we used eye-tracking to examine the gender and age specificity of visual attention in four groups: Gynephilic and androphilic men and women, all reporting attraction to adults. We used a forced attention paradigm (semi-naked adults

of the preferred gender presented simultaneously with adults of the non-preferred gender, or with semi-naked children of either gender) based on previous studies (Fromberger et al., 2012; Dawson & Chivers, 2016). We examined time to first fixation and total duration of fixation as our early and late visual attention measures, respectively. We conducted two experiments, first contrasting target gender and then contrasting target age.

We predicted that (1) time to first fixation would be shorter toward sexually preferred adults, consistent with participant sexual gender and age orientations; and (2) the total duration of fixation would be longer toward sexually preferred adults, consistent with participant sexual orientations; (3) time to first fixation would be shorter toward adults than toward children, regardless of participant gender or their sexual gender orientation; (4) the total duration of fixation would be longer toward adults than toward children, regardless of participant gender or their sexual gender orientation; and, (5) androphilic women would show a non-specific visual pattern towards stimuli of both genders, while gynephilic women, as well as gynephilic and androphilic men, would show shorter time to first fixation and longer total duration of fixation towards stimuli of their preferred gender. We further distinguished targets according to areas of interest – face, chest, or pelvis – to determine which targets were most salient. Here, we predicted (6) that time to first fixation would be shorter toward specific all areas of interest of sexually preferred adults; and (7) total duration of fixation would be longer toward all specific areas of interest of sexually preferred adults.

3.3 Experiment 1

3.3.1 Participants

In Experiment 1, the final sample consisted of 99 students from Bogota, Colombia with ages ranging from 18 to 29 years old (*M* = 20.5, *SD*= 2.3), of whom 34 were gynephilic men (*M*= 21.7; *SD*= 3.1), 23 androphilic men (*M*= 20.7; *SD*= 1.7), 25 androphilic women (*M*= 19.2; *SD*= 1.1), and 17 gynephilic women (*M*= 20.1; *SD*= 1.3).

All participants were recruited through public advertisements posted in several faculties or contacted directly during class. Each volunteer was classified using the Kinsey scale (Kinsey, Pomeroy, & Martin, 1948), and only those who scored 0 (exclusively heterosexual), 1 (predominantly heterosexual), 5 (predominantly homosexual), or 6 (exclusively homosexual) were included. Men who scored 0 or 1 were classified as "gynephilic" and those who scored 5 or 6 were classified as "androphilic", while the converse classification was used for women (Dawson, Fretz, & Chivers, 2017).

All participants completed an initial questionnaire about sociodemographic characteristics and medical and psychological history. Those who had a history of neurological problems, psychiatric problems, or uncorrected vision were excluded from the study. Volunteers who met the selection criteria then received a series of questionnaires about their sexual behaviour history, children and sex cognitions (Waldron et al., 2006), and sexual fantasies (Wilson, 2010; Wilson & Lang, 1981). Only participants who scored 0 or 1 on the children and sex cognitions scale, and who did not report having any sexual fantasies about children, took part in this study. Five participants who obtained scores over 1 were subsequently excluded from both experiments. The study was approved by the University's Committee on Research Ethics; all participants were

thoroughly informed (both in writing and orally) about what their participation involved, and all gave their written informed consent.

3.3.2 Apparatus and Materials

Eye Tracker.

Eye movements were registered and analysed using Eye Tracker Tobii Studio™, Tobii Pro X2-60 integrated with Tobii Studio Pro Version 3.3.2.1150 (Tobii Technology AB, Stockholm, Sweden), which was used to design the experiments, as well as record, play, and analyse fixations with a 60 Hz temporal resolution, a spatial resolution < 0.2° of visual angle, and a gaze precision of less than 0.5° (Tobii Technology AB, 2016). All software was installed on a Pentium Dell PC with an Intel Core 2 Duo processor (3.33 GHz) on a Windows 7 64-bit operating system. Participants viewed the stimuli on a 17″ TFT monitor with a 1440 x 900 screen resolution and 60 Hz refresh rate.

Stimuli.

The experimental design was carried out according to the parameters established by Fromberger et al. (Fromberger et al., 2013) and Fromberger, Jordan, Von Herder, et al. (Fromberger, Jordan, Von Herder, et al., 2012). We used 64 images taken from freely accessible internet sites depicting non-erotic and non-pornographic semi-naked figures wearing underwear or a swimsuit, with a neutral facial expression. The 64 images were divided into four equal categories depicting adult men, adult women, male children, or female children. To classify stimuli according to their perceived age, 4 men (M_{age} = 23.2 years; *SD*= 5.6) and 4 women (M_{age} = 21.9; *SD*= 3.3) rated all stimuli. For boys and girls separately, the 16 child images were further equally divided into images with a mean perceived age of under 9 (perceived age: girls *M* = 8.9; *SD* = 0.8; boys *M* = 8.7; *SD* = 0.7)

or between 10 and 12 years old (girls *M* = 11.66; *SD* = 0.56; boys *M* = 11.75; *SD* = 0.44). The mean perceived age of adults was always between 25 and 30 years old (women *M* = 26.4; *SD* = 3.7; men *M* = 28.4; *SD* = 1.7). All images were transformed to a grey scale, eliminating any background colour, matched for contrast and brightness, and presented on a white background.

In Experiment 1, participants viewed simultaneous targets that differed in gender, but not age (man versus woman; boy versus girl). Target stimuli were presented following Fromberger, Jordan, Von Herder, et al.'s (Fromberger, Jordan, Von Herder, et al., 2012) design, including the position of the images on the screen, the duration of each trial, and the fixation point between trials, as well as the design, number of practice trials, and pseudo-randomization. Each image had a height of 453 pixels, with a distance between images of 680 pixels, calculated from the centre of one to the centre of the other.

Subjective sexual attraction.

After participants finished the eye-tracking part of the experiment, all stimuli were presented again, individually, and participants were asked to rate them for valence (sexual attractiveness) and arousal (sexual arousal) on a 9-point pictographic scale (valence 1= unpleasant to 9= pleasant; sexual arousal 1 = not arousing to 9= arousing; Bradley & Lang, 1994). These images were presented in the centre of the screen.

3.3.3 Procedure

After completing all the relevant study questionnaires, participants were given individual appointments at the Experimental Psychology Lab. After giving their written informed consent, they were seated 65 cm from the computer monitor and provided with detailed instructions about the task and the body posture they should adopt. Eye-tracking

calibration consisted of gaze following and fixation on a point across 9 places on the screen. Next, participants read the instruction "watch freely, as you normally would, the images that are going to appear on the screen". They were informed that their eye movements would be recorded. Both experiments started with 8 practice trials and continued with the presentation of the 64 experimental trials with a fixation point between images. Practice and experimental trials were comparable, but differed in that practice stimuli were fully clothed. Each experiment had duration of 7 minutes (5 s per image, preceded by a fixation point for 500 ms). Unlike in previous studies (Dawson & Chivers, 2016; Fromberger, Jordan, Von Herder, et al., 2012), the subjective assessment of the images' valence and arousal was performed after the recording of ocular movements, to avoid potentially influencing the *natural* eye-patterns of participants (Fromberger, Jordan, Von Herder, et al., 2012).

3.3.4 Statistical Analyses

For fixation identification, the Tobii Fixation Filter was used, which removes saccadic movements and filters the fixations. The dispersion threshold for the fixations was 30 pixels, with a minimum duration of 100 ms. If the speed is kept below this threshold, data are assigned to the same fixation (Dawson & Chivers, 2016). Data were analysed using mixed-design general linear models for each dependent variable (time to first fixation and total duration of all fixations, as described in (Dawson & Chivers, 2016; Fromberger, Jordan, Von Herder, et al., 2012), according to four areas of interest: one global (entire body), and three specific (face, chest, and pelvis), with Bonferroni correction to $\alpha = .0125$ because we performed four analyses. Target gender was treated as a within-subjects factor, and participant gender and sexual orientation as between-

subjects factors. *Post-hoc* pairwise comparisons (*t*-tests) were conducted for significant effects of target gender. All tests were two-tailed.

3.3.5 Results

We report the full main effects and interactions for time to first fixation (Table 1) and total duration of fixation (Table 2), with an emphasis on describing within-subject effects involving target gender.

Time to first fixation.

The main general linear model analysis revealed that target gender had an effect on first fixation (Table 1) for the entire body that, however, was not significant after Bonferroni correction ($p = .019$); participants tended to fixate faster on female than male targets (Fig. 1a), mainly because of the strong preference for female targets shown by gynephilic men and women, but also because of early attention that androphilic women showed to girl targets. For viewing of the entire body, we found significant interactions between target gender and participant gender, as well as between target gender, participant gender, and participant sexual orientation, and finally a four-way interaction between target age, target gender, participant gender, and participant sexual orientation: Gynephilic men and women fixated faster on female targets (either adult or child), whereas androphilic men fixated faster on target men but not target boys. Androphilic women, in contrast, took a similar time to fixate on target men or women, but fixated faster on girl than boy targets (Fig. 1a).

For specific areas of interest, there was a significant interaction between target and participant gender for viewing of the face, chest and pelvis (Fig. 1b,c,d), where participants tended to fixate faster on same-gender targets. We also found a significant

three-way interaction among target gender, participant gender, and participant sexual orientation for the face area (Table 1). In this case gynephilic men and women fixated faster on female targets, whereas androphilic men fixated faster on male targets. Androphilic women, in contrast, took a similar time to fixate on face (Fig. 1b). For the chest, there was also a significant interaction between target gender and age. Participants took longer to fixate on boy versus girl targets, whereas this target gender difference in time to first fixation was not found for adult targets (Fig. 1c).

Table 1.
Time to first fixation, Experiment 1.

Effect	**Area of Interest (AOI)**							
	Body		**Face**		**Chest**		**Pelvis**	
Within-subject Effect	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p
TG	5.72	.06	0.88	.01	1.718	.02	2.67	.03
TG*PG	**27.63****	**.23**	**12.35****	**.12**	**15.32****	**.14**	**13.63****	**.13**
TG*PSO	4.12	.04	5.06	.05	1.77	.02	3.47	.04
TG*PG*PSO	**38.62****	**.29**	**21.51****	**.19**	0.54	.01	3.21	.03
TA	**13.11****	**.12**	**40.85****	**.31**	0.24	.003	1.00	.01
TA*PG	0.66	.007	0.5	.01	0.41	.004	0.06	.001
TA*PSO	4.07	.04	6.28	.06	2.72	.03	2.73	.03
TA*PG*PSO	0.36	.004	1.17	.01	0.12	.001	1.2	.01
TG*TA	4.96	.05	1.23	.01	**16.42****	**.15**	0.09	.001
TG*TA*PG	0.08	.001	0.01	<.001	2.47	.03	0.98	.01
TG*TA*PSO	4.42	.04	2.26	.02	1.69	.02	2.19	.02
TG*TA*PG*PSO	**8.66***	**.08**	1.12	.01	4.58	.05	<.001	<.001
Between-subject Effect	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p
PG	0.01	<.001	2.87	.03	0.36	.004	1.36	.01
PSO	0.1	<.001	0.41	.004	0.87	.01	2.57	.03
PG*PSO	1.07	.01	0.9	.01	2.08	.02	1.32	.01

TG = Target gender, TA = Target Age, PG = Participant gender, PSO = Participant Sexual Orientation. Results are from repeated-measures generalized linear models (d.f. = 1, 95 for body, 1, 92 for face, 1, 95 for chest, and 1, 90 for pelvis,) for each Area of Interest, with Bonferroni adjustment for multiple tests ($\alpha = .0125$). Significant effects are in bold: *p < .0125; **p < .001. For detailed results, see Table S1 in the Supplementary Material.

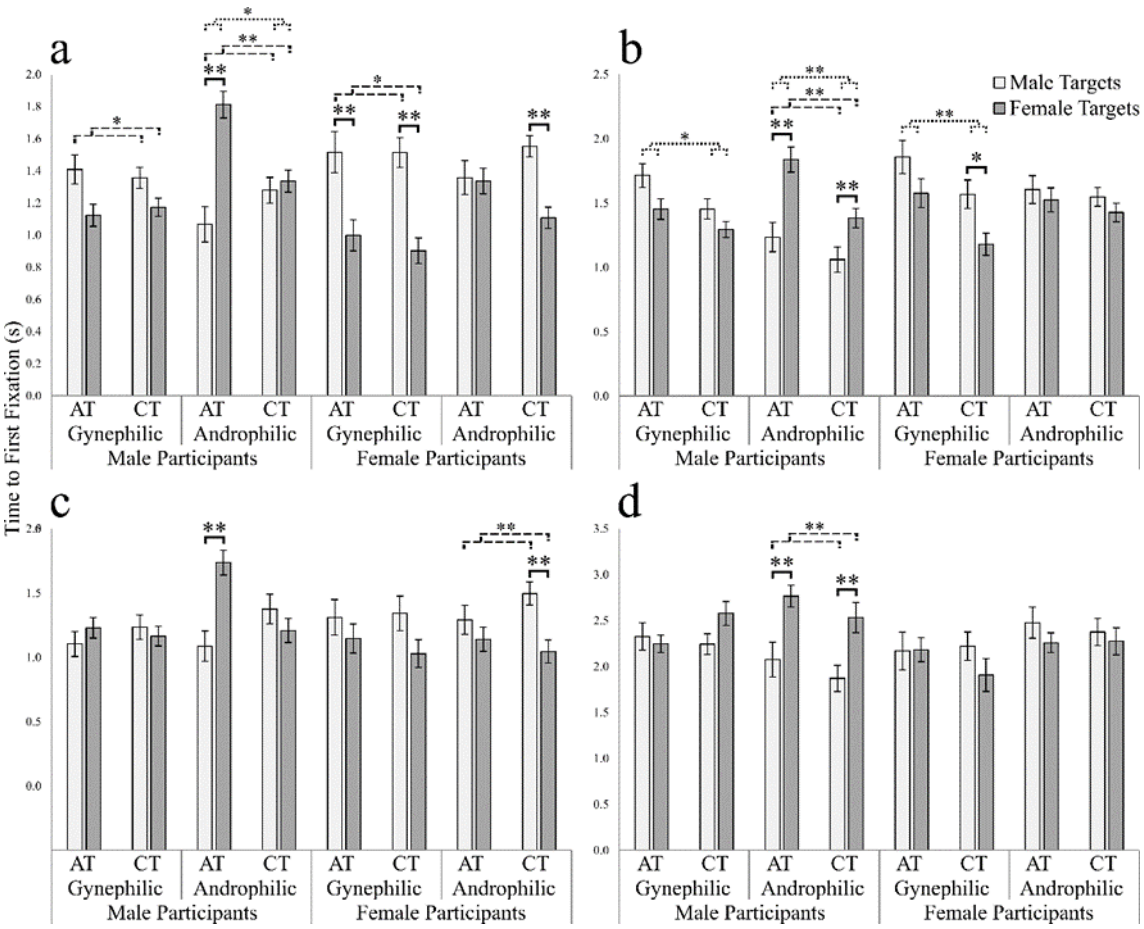

Figure 1. Experiment 1, time to first fixation (TFF) by area of interest, split by target gender (male targets: white bars; female targets: grey bars) and target age (AT: adult targets; CT: child targets), as well as sexual orientation (gynephilic, androphilic) and gender (male, female) of the participants. (a) Entire body; (b) face; (c) chest; (d) pelvis. Bars represent estimated marginal means ± 1 S.E.M. For interactions, dashed lines represent an effect of target gender (male, female); dotted lines represent an effect of target age (adult, child). Post-hoc tests, **p*<.0125; ***p*<.001. For detailed results, see Table S2 (post-hoc GLMs) and Table S3 (post-hoc *t*-tests) in the Supplementary Results.

Total duration of fixation.

For the entire body, a main effect of target gender was found on duration of fixation: Participants tended to look longer at the entire body of female than male targets (Table 2). The three-way interaction of target gender, participant gender, and participant sexual orientation was significant for the entire body. Participants fixated for a longer total time on the target gender that corresponded to their sexual orientation (Fig. 2a). We also found a significant four-way interaction, in which participants fixated longer on the adult target predicted by their gender and sexual orientation (Fig. 2a). However, durations of fixation of female participants were significantly longer for girl compared to boy targets, regardless of sexual orientation, and the same thing was true in gynephilic men (Fig. 2a).

Analyses of specific areas revealed that participants tended to look longer at the pelvis of female targets than male targets (Table 2). In fact, the three-way interaction of target gender, participant gender, and participant sexual orientation was significant and similar for all areas of interest. Participants fixated for a longer total time on the target gender that corresponded to their sexual orientation (Fig. 2b, c, d). Additionally, we found a significant interaction between target gender and age for the chest and pelvis areas, as participants tended to fixate longer on the erotic areas of target women than target men, and for significantly less time on the pelvis of boys or girls (Fig. 2c,d). We also found a significant four-way interaction for all specific areas of interest. In all cases, participants fixated longer on the adult target predicted by their gender and sexual orientation (Fig. 2b,c,d). For the chest, durations of fixation of female participants for the chest were significantly longer for girls compared to boy targets, regardless of sexual orientation (Fig. 2c). For the face and pelvis, participants showed no differences in total fixation times when comparing boy and girl targets (Fig. 2b, d).

Participants spent more time viewing faces than the chest or pelvis, $F(2, 190) = 112.79$, $p < .001$, $\eta^2_p = .54$ (Fig. 2e). Planned contrasts (Helmert) showed that participants spent a significantly longer time looking at faces (mean ± S.E.M. = .57 ± .03 s) than at the chest or pelvis, $F(1, 95) = 118.39$, $p < .001$, $\eta^2_p = .55$, and their duration was longer on the chest (.26 ± .01 s) than on the pelvis of the targets (.19 ± .01 s), $F(1, 95) = 45.08$, $p < .001$, $\eta^2_p = .32$. This effect was stronger for preferred targets based on sexual orientation, $F(2, 190) = 6.93$, $p < .001$, $\eta^2_p = .07$. Duration of fixation on the chest and pelvis was similar for target men, but it was longer for the chest than the pelvis for target women or girls: $F(2, 190) = 6.93$, $p = .001$, $\eta^2_p = .19$.

Table 2.
Total duration of fixation (TDF), Experiment 1.

Effect	**Area of Interest (AOI)**							
	Body		**Face**		**Chest**		**Pelvis**	
Within-subject Effect	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p
TG	**8.81****	**.10**	2.4	0.02	0.448	.005	**8.08****	**.08**
TG*PG	3.10	.04	0.35	0.004	5.99	.06	4.67	.05
TG*PSO	0.003	<.001	0.37	0.004	0.02	<.001	0.44	.005
TG*PG*PSO	**130.88****	**.57**	**69.88****	**0.42**	**88.93****	**.48**	**102.08****	**.52**
TA	**90.14****	**.48**	**48.71****	**0.34**	**198.73****	**.68**	**293.19****	**.76**
TA*PG	1.08	.01	0.91	0.01	0.05	.001	0.43	.005
TA*PSO	0.21	.002	<.001	<.001	0.14	.001	0.05	.001
TA*PG*PSO	0.16	.002	0.27	0.003	0.32	.003	**7.98****	**.08**
TG*TA	1.11	.01	2.24	0.02	**13.52****	**.12**	**30.77****	**.24**
TG*TA*PG	0.04	.00	0.07	0.001	0.13	.001	5.12	.05
TG*TA*PSO	1.13	.01	0.89	0.01	0.63	.01	0.55	.01
TG*TA*PG*PSO	**153.71****	**.62**	**31.27****	0.25	**91.04****	**.49**	**131.36****	**.58**
Between-subject Effect	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p
PG	2.01	.02	0.02	<.001	1.62	.02	3.12	.03
PSO	1.26	.01	0.63	0.01	0	<.001	3.11	.03
PG*PSO	4.39	.04	0.08	0.001	3.82	.04	**8.89****	**.09**

TG = Target gender, TA = Target Age, PG = Participant gender, PSO = Participant Sexual Orientation. Results are from repeated-measures generalized linear models (d.f. = 1, 95 for body, 1, 85 for Face, 1, 85 for Chest, and 1, 78 for Pelvis) for each Area of Interest, with Bonferroni adjustment for multiple tests (α = .0125). Significant effects are in bold: *p < .0125; **p < .001. For descriptive statistics, see Table S3 in the Supplementary Material.

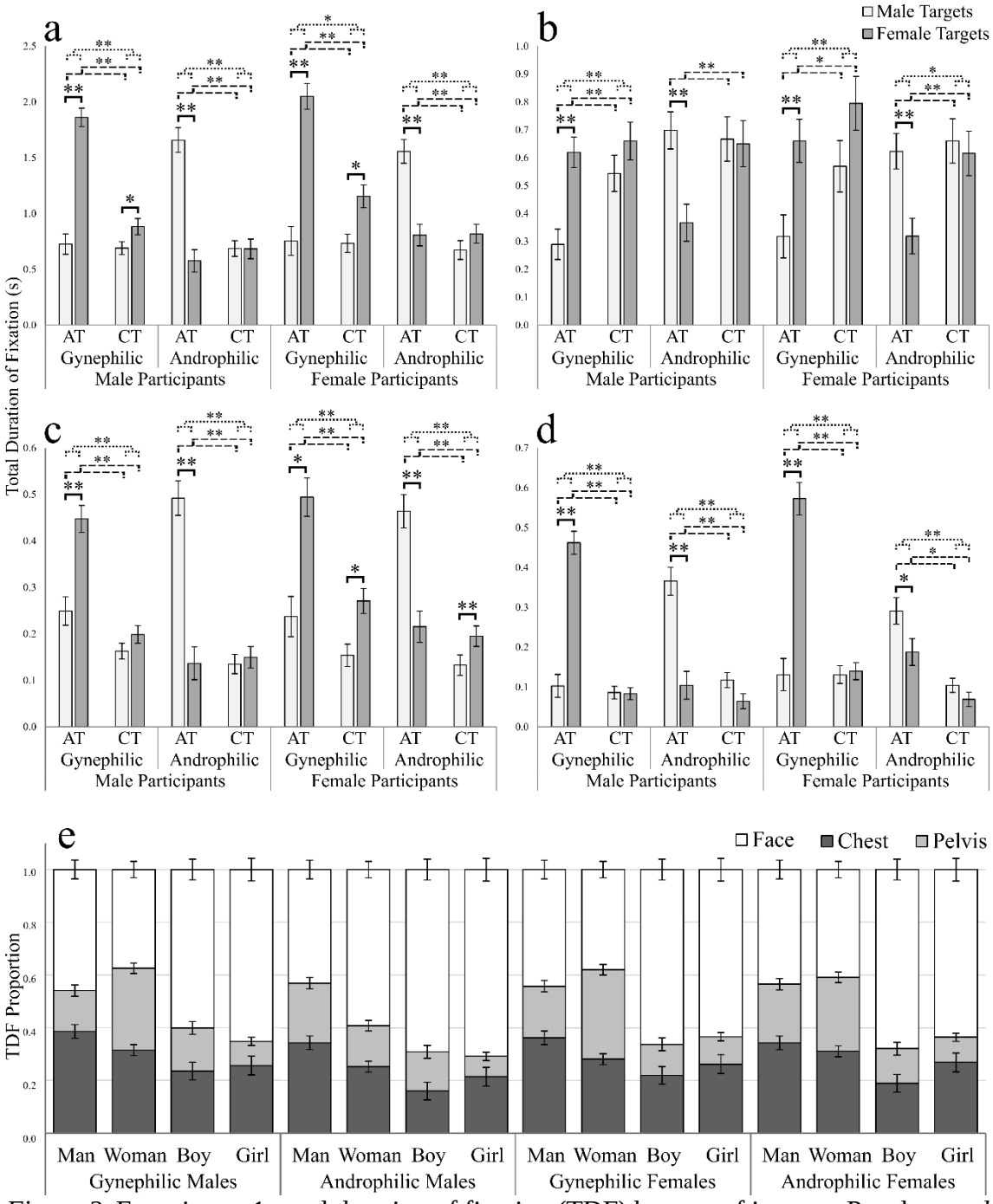

Figure 2. Experiment 1, total duration of fixation (TDF) by area of interest. Panels *a* to *d* are split by target gender (male targets: white bars; female targets: grey bars) and target age (AT: adult targets; CT: child targets), as well as sexual orientation (gynephilic, androphilic) and gender (male, female) of the participants. (a) Entire body; (b) face; (c) chest; (d) pelvis (e) Total duration of fixation (TDF) proportion by area of interest (AOI) (chest: dark grey; pelvis: light grey; face: white bars), by gender (male, female) and sexual orientation of the participants (gynephilic, androphilic), as well as target (men, women, boys, girls). Bars represent estimated marginal means ± 1 S.E.M. For interactions, dashed lines represent an effect of target gender (male, female); dotted lines represent an effect of target age (adult, child). Post-hoc tests, **p*<.0125; ***p*<.001. For detailed results, see Table S5 (post-hoc GLMs) and Table S6 (post-hoc *t*-tests) in the Supplementary Results.

3.4 Experiment 2

3.4.1 Participants and Procedure

Participants from Experiment 1 and 2 were the same, but their data were analysed, or excluded, depending on eye-tracking calibration for each experiment. Participants did both experiments in the same session, but the order of experiments was counterbalanced. For Experiment 2, the final sample consisted of 98 university students between 19 and 29 years old (*M* = 20.4, *SD*= 2.2) from Bogota, Colombia, classified as follows: 32 gynephilic men (*M*= 21.5; *SD*= 3.0), 23 androphilic men (*M*= 20.4; *SD*= 1.7), 25 androphilic women (*M*= 19.2; *SD*= 1.1), and 18 gynephilic women (*M*= 20.1; *SD*= 1.3). The same procedures were used in Experiment 2 as in Experiment 1, except that participants were presented with pairs of targets that differed in age, but not gender (man versus boy; woman versus girl). Target age was treated as a within-subjects factor, and participant gender and sexual orientation as between-subjects factors. *Post-hoc* pairwise comparisons (*t*-tests) were conducted for significant effects of target age. All tests were two-tailed.

3.4.2 Results

We report the main effects and interactions in Tables 3 (first fixation) and 4 (duration). Here, the results emphasize within-subject effects involving target age to reflect the experimental design.

Time to first fixation.

Our analysis showed that target age had a main effect on time to first fixation for the entire body. Participants tended to fixate faster on the entire body of adult targets compared to child targets (Fig. 3a). Target age did not significantly interact with any other variable.

For specific areas of interest, there was a significant main effect of target age for viewing of the pelvis area, in which participants fixated faster on adult compared to child stimuli. We also found a significant interaction of participant gender and sexual orientation with target age and gender for the chest: Gynephilic men, but not gynephilic women, took significantly more time to fixate on the chest of women versus girl targets, whereas no differences were found when they looked at male (adult or child) targets (Fig. 3c). Finally, there was a significant interaction between target age and gender for the pelvis (Table 3), as participants tended to fixate more slowly on the pelvis of girl targets, whereas no differences were found when viewing child or adult male targets (Fig. 3d).

Table 3.
Time to first fixation, Experiment 2.

Effect	**Area of Interest (AOI)**							
	Body		**Face**		**Chest**		**Pelvis**	
Within-subject Effect	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p
TA	**12.41****	**.12**	0.20	.002	3.83	.04	**8.76***	**.12**
TA*PG	0.256	.003	0.55	.01	3.42	.04	0.33	.01
TA*PSO	0.079	.001	0.09	.001	0.64	.01	0.01	<.001
TA*PG*PSO	0.202	.002	0.11	.001	1.37	.01	<.001	<.001
TG	0.753	.01	0.12	.001	4.086	.04	2.39	.04
TG*PG	3.375	.04	3.27	.03	0.70	.01	<.001	<.001
TG*PSO	1.393	.02	3.48	.04	0.18	.002	0.26	.004
TG*PG*PSO	4.938	.05	0.41	.004	3.88	.04	<.001	<.001
TA*TG	1.039	.01	0.05	.001	6.21	.06	**8.41***	**.12**
TA*TG*PG	0.610	.01	1.26	.01	0.18	.002	0.86	.01
TA*TG*PSO	0.217	.002	1.04	.01	0.47	.01	5.67	.08
TA*TG*PG*PSO	1.007	.01	1.90	.02	**14.68****	**.14**	0.02	<.001
Between-subject Effect	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p
PG	0.50	.005	1.65	.02	4.80	.05	0.01	0
PSO	0.00	<.001	0.00	<.001	0.06	.001	1.26	.02
PG*PSO	0.02	<.001	0.67	.01	0.41	.005	0.08	.001

TA = Target Age, TS = Target gender PS = Participant gender, PSO = Participant Sexual Orientation. Results are from repeated-measures generalized linear models (d.f. = 1, 94 for entire body, 1, 91 for Face, 1, 90 for Chest, and 1, 64 for Pelvis) for each Area of Interest, with Bonferroni adjustment for multiple tests ($\alpha = .0125$). Significant effects are in bold: *p < .0125; **p < .001. For effect sizes $\eta^2_p > .01$ = small, $\eta^2_p > .06$ = medium, and $\eta^2_p > .14$ = large (Cohen, 1988; Miles & Shevlin, 2001). For descriptive statistics, see Table S5 in the Supplementary Material.

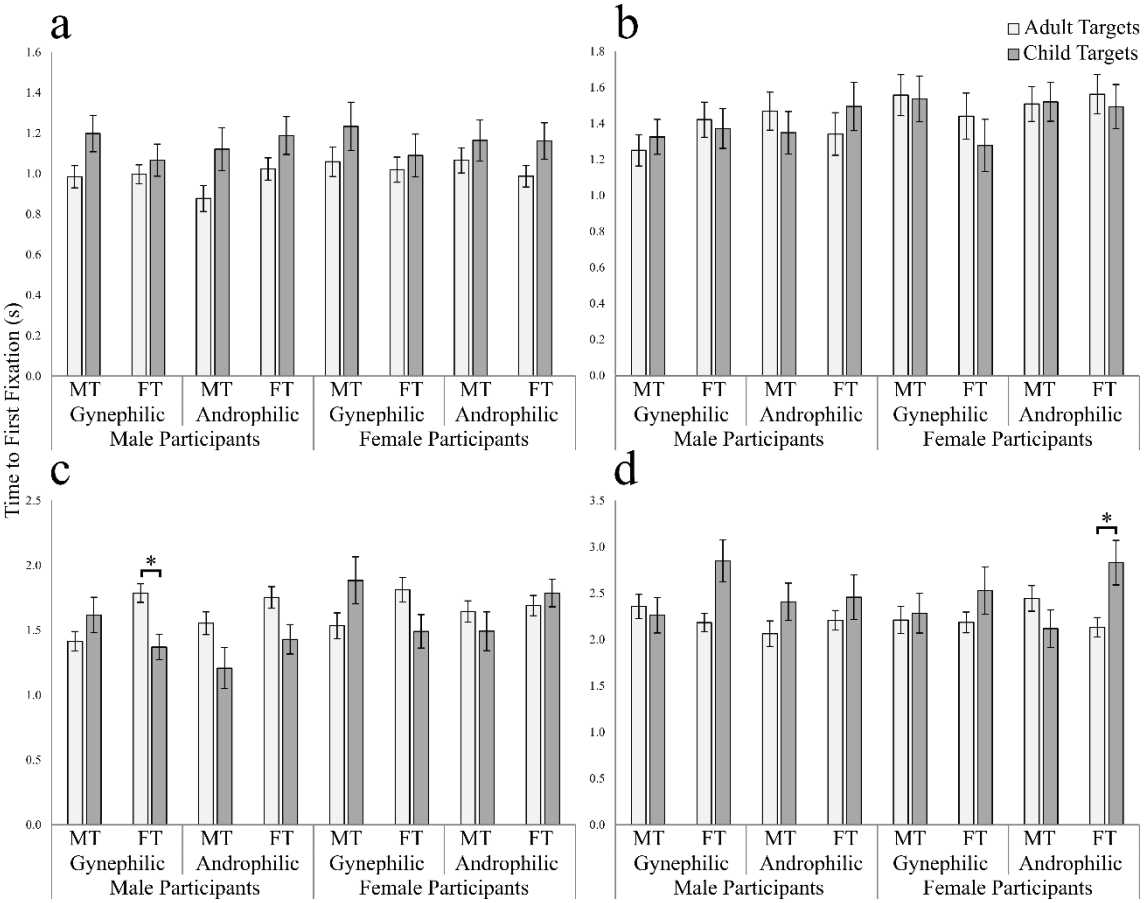

Figure 3. Experiment 2, time to first fixation (TFF) by area of interest, split by target age (adult targets: white bars; child targets: grey bars) and target gender (MT: male targets; FT: female target), as well as sexual orientation (gynephilic, androphilic) and gender (male, female) of the participants. (a) Entire body; (b) face; (c) chest; (d) pelvis. Bars represent estimated marginal means ± 1 S.E.M. *Post-hoc* tests, **p*<.0125; ***p*<.001. For detailed results, see Table S8 (post-hoc GLMs) and Table S9 (post-hoc *t*-tests) in the Supplementary Results.

Total duration of fixation.

Results showed a main effect of target age on duration of fixation for all areas of interest (Table 4), such that participants tended to fixate longer on all areas of adult compared to child targets (Fig. 4). For the entire body, participants looked for a longer total time adult in comparison to child targets. Furthermore, the four-way interaction between target age, target gender, participant gender, and participant sexual orientation was significant; both men and women, regardless of their sexual orientation, had longer total duration of fixations towards the entire bodies of adults of their preferred gender.

For specific areas of interest, we found a significant interaction between target age and gender for erotic areas, as participants tended to fixate longer on the chest or pelvis of adult targets than of child targets, especially when these targets were men (for the chest), or women (for the pelvis) (Fig. 4c, d). For the chest, this effect was driven mainly by androphilic men and women, who fixated longer on the chest of target men compared to target women. For the pelvis, this result was driven by gynephilic men and women, who fixated longer on the pelvis of target women than target girls or males of either age. We found a significant four-way interaction involving target age, target gender, participant gender, and participant sexual orientation: Participants looked longer at both erotic and non-erotic regions of adults of their preferred gender, consistent with their stated sexual preferences (Fig. 4a-d).

Despite differences in total duration of fixation based on target age, participants spent more time viewing faces than other areas of interest, especially the chest and pelvis, $F(2, 188) = 84.22$, $p < .001$, $\eta 2p = .47$ (Fig. 4e). Planned contrasts (Helmert) showed that the duration of fixation for faces (mean ± S.E.M. =.51 ± .03 s) was significantly higher than for the chest or pelvis, $F(1, 94) = 84.96$, $p < .001$, $\eta 2p = .48$, and that participants

spent significantly more time looking at the chest (.27 ± .01 s) than at the pelvis of the targets (.17 ± .01 s), F(1, 94) = 76.70, p < .001, η2p = .45. This was particularly true for non-preferred targets, that is, child targets, or adult targets that did not correspond to their sexual orientation (interaction among AOI, TA and TS: F(2, 188) = 40.32, p < .001, η2p = .30).

Table 4.
Total duration of fixation (TDF), Experiment 2.

Effect	**Area of Interest (AOI)**							
	Body		**Face**		**Chest**		**Pelvis**	
Within-subject Effect	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p
TA	**332.06****	**.78**	**48.66****	**.34**	**294.34****	**.76**	**284.99****	**0.75**
TA*PG	2.45	.03	1.55	.02	1.63	.02	0.15	0.002
TA*PSO	6.15	.06	**6.79***	**.07**	0.31	.003	3.27	0.03
TA*PG*PSO	0.15	.002	0.06	.00	1.75	.02	2.14	0.02
TG	0.00	.000	**12.49****	**.12**	**8.82****	**.09**	**27.39****	**0.23**
TG*PG	0.01	.000	1.75	.02	0.08	.001	0.1	0.001
TG*PSO	4.10	.04	0.97	.01	0.40	.004	4.26	0.04
TG*PG*PSO	**25.26****	**.21**	4.65	.05	3.78	.04	**42.10****	**0.31**
TA*TG	1.13	.01	4.04	.04	**15.34****	**.14**	**57.10****	**0.38**
TA*TG*PG	1.01	.01	3.65	.04	0.61	.01	0.09	0.001
TA*TG*PSO	0.10	.001	0.38	.004	0.001	<.001	1.97	0.02
TA*TG*PG*PSO	**75.34****	**.44**	**44.70****	**.32**	**15.17****	**.14**	**60.52****	**0.39**
Between-subject Effect	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p	*F*	η^2_p
PG	0.19	.002	0.07	.001	0.25	.003	1.83	0.02
PSO	2.72	.03	0.75	.01	0.04	<.001	5.22	0.05
PG*PSO	1.12	.01	0.72	.01	0.65	.01	4.91	0.05

TA = Target Age, TS = Target gender PS = Participant gender, PSO = Participant Sexual Orientation. Results are from repeated-measures generalized linear models (d.f. = 1, 94 in all cases) for each Area of Interest, with Bonferroni adjustment for multiple tests (α = .0125). Significant effects are in bold: *p < .0125; **p < .001. For descriptive statistics, see Table S7 in the Supplementary Material.

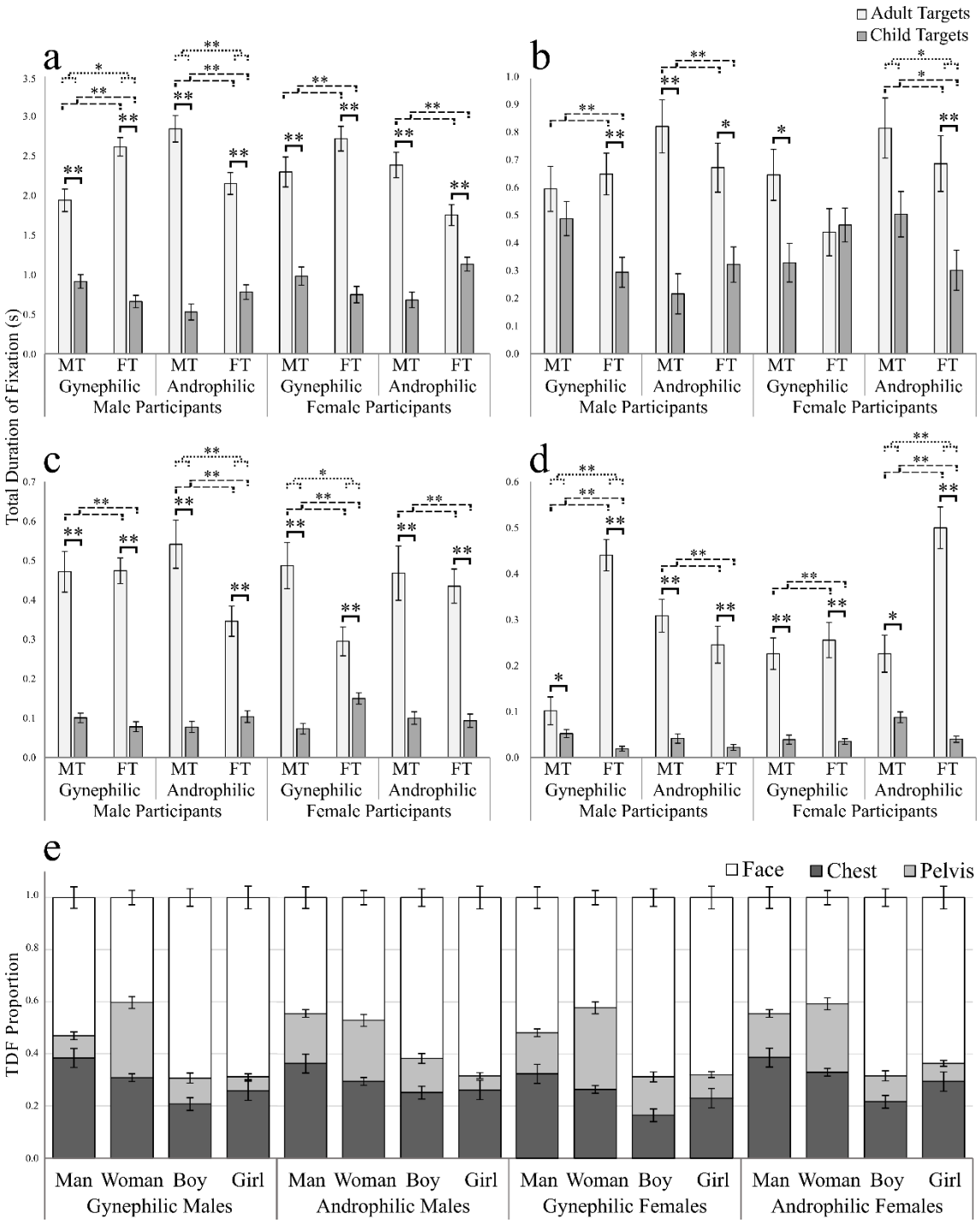

Figure 4. Experiment 2, total duration of fixation (TDF) by area of interest. Panels *a* to *d* are split by target age (adult targets: white bars; child targets: grey bars) and target gender (MT: male targets; FT: female targets), as well as sexual orientation (gynephilic, androphilic) and gender (male, female) of the participants. (a) Entire body; (b) face; (c) chest; (d) pelvis. (e) Total duration of fixation (TDF) proportion by area of interest (AOI) (chest: dark grey; pelvis: light grey; face: white bars), by gender (male, female) and sexual orientation of the participants (gynephilic, androphilic), as well as target (men, women, boys, girls). Bars represent estimated marginal means ± 1 S.E.M. For interactions, dotted lines represent an effect of target age (adult, child); dashed lines represent an effect of target gender (male, female). Post-hoc tests, **p*<.0125; ***p*<.001. For detailed results, see Table S11 (post-hoc GLMs) and Table S12 (post-hoc *t*-tests) in the Supplementary Results.

3.5 Subjective Sexual Attraction

Sexual valence and arousal ratings to each stimulus given by all participants, were analysed using GLM models, equivalent to those used for eye-tracking data, with target gender and age as within-subject factors, and participant gender and sexual orientation as between-subject factors. Descriptive statistics (means and standard deviations) are provided in Table S13 in the supplementary materials.

For both valence and arousal, the patter of significant results was the same ($p < .001$ in all cases); there was a main effect of age of the stimuli on the valence and arousal reported by the participants, such that participants rated adult stimuli as more attractive and more arousing than child stimuli (valence: $F(1, 95) = 172.39$, $\eta^2_p = .65$; arousal: $F(1, 95) = 325.41$, $\eta^2_p = .77$). Furthermore, results revealed interactions between gender of the stimuli, and gender and sexual orientation of the participants (valence: $F(1, 95) = 124.67$, $\eta^2_p = .57$; arousal: $F(1, 95) = 235.50$, $\eta^2_p = .71$), and a four-way interaction between gender and age of the stimuli, and gender and sexual orientation of the participants (valence: $F(1, 95) = 136.28$, $\eta^2_p = .59$; arousal: $F(1, 95) = 215.04$, $\eta^2_p = .69$); as expected, participants rated adult stimuli of their preferred gender (according to their gender and sexual orientation) as more attractive and more sexually arousing (Fig. S1). Additionally, and only for arousal, there was a significant interaction between age of the stimuli and sexual orientation of the participant, in which reported arousal to adult stimuli was higher in androphilic men and gynephilic women than gynephilic men and androphilic women, $F(1, 95) = 11.78$, $p = .001$, $\eta^2_p = .11$ (Fig. S1b).

3.6 Discussion

3.6.1 Summary of Results

Our findings indicate participants attended to sexual maturity characteristics in adults, especially of their preferred gender. Attentional patterns of gynephilic men and women were very similar, as were, to a lesser extent, the attention patterns of androphilic men and women, consistent with the idea that men and women were attending to the same cues in their preferred gender targets. Gynephilic women as well as both androphilic and gynephilic men showed gender-specific early and late attention, whereas androphilic women showed gender-nonspecific early attention and gender-specific late attention.

All four groups showed age specific early and late attention, but with some interesting interactions involving participant gender, target gender, and participant sexual orientation. The patterns of early and late attention suggested the process by which targets varying in age are evaluated for sexual maturity and thus for sexual interest, among participants who prefer adults. These results were novel because prior studies did not include all of these participant groups. As discussed next, some of these results replicated prior research, but other results differed.

3.6.2 Effect of target gender

We found strong support for gender specificity in both groups of men and for gynephilic women, for both early and late attention. However, androphilic women showed gender-nonspecificity in their early attention, consistent with previous research (Attard-Johnson et al., 2016; Dawson & Chivers, 2016). We found that the entire body of the preferred gender attracts the early attention of gynephilic men and women, and of

androphilic men, consistent with previous findings using eye tracking (Dawson & Chivers, 2016) or other indirect measures (Rieger et al, 2015; Rieger & Savin-Williams, 2012).

Early attention.

Unlike Samson and Janssen (Samson & Janssen, 2014) and Rieger et al. (2015), we found androphilic men showed specific early attention toward their preferred stimuli, for all erotic and non-erotic areas of interest. Interestingly, we also found non-specificity in early attention for gender in androphilic women (Chivers, 2017; Dawson & Chivers, 2016), but this interacted with target age: these women showed significantly faster first fixation to the entire body and chest of girls than of boys. Moreover, in androphilic women, we found no differences for the face, the area that attracted the attention faster for all other participant groups, who showed specific early attention on the face of stimuli of the preferred gender.

Late attention.

Total duration of fixation was clearly influenced by participant gender and sexual orientation, consistent with past work on later attention (Dawson & Chivers, 2016; Rullo, Strassberg, & Israel, 2010). In this study, all participants showed more late visual attention to adult stimuli of their preferred gender, including erotic (chest, pelvis) and non-erotic (face) areas. Although some differences were observed, especially in androphilic women, duration results were mostly consistent with time to first fixation results. For duration of fixation, however, both groups of women looked longer at the entire body and chest of girls than of boys, consistent with previous research of androphilic women, who did not show a specific visual pattern towards adult men, and

tended to look more frequently and more time to the chest and pelvis areas of female targets, regardless of age (Hall et al., 2011).

Compared with the pelvis of target men, the pelvis of target women again attracted the longest duration of fixation in gynephilic men and women. In contrast, the pelvis of children was the least observed area by all participants, suggesting this could be a critical cue for distinguishing individuals with paedophilic interests (Fromberger, Jordan, Von Herder, et al., 2012).

More late attention was given to the face compared to the chest or pelvis, but this effect was modulated by sexual preference: More attention was directed to the chest and pelvis and less attention was given to the face for preferred targets. In spite of this, differences in duration of fixation were found between faces only when comparing preferred adults to non-preferred targets. This makes sense given the modulatory role the face has in sexual preferences and mate choice (Hewig et al., 2008; Kranz & Ishai, 2006, Hahn, Fisher, DeBruine, & Jones, 2016; Mitrovic et al., 2016).

3.6.3 Effect of target age

We found age specific early and later attention for all participant groups.

Early attention.

Consistent with Fromberger et al. (Fromberger et al., 2013), early attention was drawn to the entire body. When an adult stimulus appeared in competition with a child image, there were no consistent differences between groups in time to first fixation toward the chest, pelvis, or face, but when analysing responses for the entire body, attention was significantly faster to adults than toward children, with a medium to large effect size. This result suggests that what attracts early attention are not specific areas (face, chest, pelvis),

but rather the overall body shape, as suggested in previous studies (Fromberger et al., 2013; Fromberger, Jordan, Von Herder, et al., 2012). Conversely, although the face is the specific area of interest that attracts attention the fastest, we found no differences in time to first fixation between adult and child faces. It is possible that the attentional system prioritizes overall body shape and its salience is what guides the initial attention to adult stimuli, regardless of the gender or sexual orientation of the viewer. This idea is consistent with Kurt Freund's speculation that body shape is a key determinant of paedophilic sexual response; for example, this could explain why paedophilic men distinguish less between stimuli depicting boys or girls, who are not so different in body shape, than teleiophilic men distinguish between stimuli depicting men or women, who differ greatly in terms of chest-to-waist and waist-to-hip ratios (e.g. Freund, Watson, Dickey, & Rienzo, 1991; see also Seto, 2017).

Although early attention to adult stimuli was significantly faster, all groups showed a tendency – only statistically significant for gynephilic men – to focus faster on the chest of girls compared to women, and then to observe the pelvis of adult women more quickly than the pelvis of girls. This finding suggests that, once early attention is drawn to overall body shape, it then goes to girls' chests, perhaps to confirm their sexual immaturity because girls do not have full breasts (Singh & Singh, 2011). Subsequently, attention is directed toward women's pelvises, in line with earlier research on the importance of waist-to-hip ratio as a signal of fertility and health for gynephilic men, and as a signal for intrasexual competition (comparison) in women (Buunk & Fisher, 2009, Grammer, Fink, Møller, & Thornhill, 2003; Singh & Young, 1995).

Late attention.

Results for duration of fixation were consistent with those obtained in time to first fixation (early attention), indicating an age-specific pattern of attentional response that favours adult over child targets, including all specific areas of interest, as might be expected in a non-paedophilic sample.

Duration of fixation on erotic areas (chest, pelvis) was significantly longer for preferred than non-preferred stimuli, but this difference was less marked for the face. When competing stimuli were male, attention was focused on the chest of men, and when the stimuli were female, attention was focused on the pelvis of women. This again suggests that, once attention is captured by the overall body shape, it is then directed to erotic areas that can provide information about sexual maturity, fertility, and health (Coy, Green, & Price, 2014; Jasienska, Ziomkiewicz, Ellison, Lipson, & Thune, 2004; Krupp, 2008). Which erotic area was prioritized depended on participant sexual orientation: Gynephilic men and women looked longer at the pelvis of target women, whereas androphilic women and men observed the chest of target men longer, which seems to suggest that these areas offer important information about preferred sexual partners (Grammer, Fink, Møller, & Thornhill, 2003).

Although gynephilic men and women focused for a longer time on the pelvis of women than on the pelvis of girls, we found no significant differences in the duration of fixation between women's versus girls' chests, which suggests waist-to-hip ratio is more salient than breasts when evaluating potential partners (Grammer et al., 2003; Singh & Young, 1995). Focusing on gynephilic men, they looked first faster at girls' chests, perhaps to confirm their sexual immaturity after apprehending the gestalt of body shape, but then quickly focused their attention on women's pelvis area, where they then looked

longer. These results differ from Fromberger et al. (Fromberger et al., 2013), who found that the areas most observed by gynephilic men were the faces and chests of adults when competing with children, although it should be noted that in their analyses, only data on target age (adults, children) were reported, without including target gender. Gynephilic women showed a similar response pattern as gynephilic men, consistent with previous studies suggesting gynephilic women show a more male-typical pattern of attention (Mitrovic et al., 2016; Rieger et al., 2015, 2016; Rieger & Savin-Williams, 2012; Samson & Janssen, 2014).

In the case of androphilic women and men, the area with the longest attention span was the chest of target males compared to the pelvis (Coy et al., 2014; Price, Pound, Dunn, Hopkins, & Kang, 2013). Attention to the chest of men has been suggested to be an important indicator of physical strength (e.g. waist-chest ratio, Tovée, Maisey, Vale, & Cornelissen, 1999; see also Fan, Dai, Liu, & Wu, 2005), which correlates with male attractiveness (Windhager, Schaefer, & Fink, 2011).

For competing non-preferred stimuli (non-preferred adult vs child stimuli of either gender), we found that duration of fixation was significantly longer toward the non-preferred adult than toward boys or girls, for areas of interest other than the face. For gynephilic men and androphilic women, this might reflect intrasexual competition (Buunk & Fisher, 2009; Maner, Miller, Rouby, & Gailliot, 2009). In fact, the only area of interest for which we found no significant differences was the face, which could suggest that participants observe the chest and pelvis of target adult stimuli longer, perhaps comparing their own characteristics to those of the 'rival'. For example, gynephilic men were more likely to fixate on the chest than on the pelvis of adult male stimuli. Another alternative explanation is that later attention, which is under conscious control, reflects an avoidance of looking at child stimuli, which might be construed

negatively in the context of this experiment. Our data cannot distinguish between these possible explanations.

Likewise, although we found significant differences between adult and child female stimuli on the pelvis and chest, androphilic women showed a greater difference in total duration of fixation toward the pelvis than toward the chest of women versus girls. Moreover, the pelvis of women was the only erotic area where there were also significant differences in the time to first fixation, as it was shorter on the pelvis of women than of girls, reinforcing the idea of a possible social comparison of areas that can indicate high reproductive potential and female sexual attractiveness (Dixson et al., 2011; Singh & Singh, 2011).

Finally, all the groups looked longer at the faces of children and non-sexually preferred adults than at their chest or pelvis, whereas for preferred adult stimuli, participants spent half or more of their total fixation time looking at these areas compared to the face. This result suggests that, in the absence of sexual interest, erotic areas are the least visually examined. In all four groups studied, the least-attended area on children was the pelvic area, which is consistent with the results of Fromberger et al (2012), who also found that people without paedophilic interests spend less time observing the pelvic area of children compared to adults.

3.6.4 Limitations

The exploration of automatic cognitive processes seems to be relevant in the identification of involuntary attentional biases to relevant sexual stimuli, given the main effects found for time to first fixation. However, significant differences were not clear between preferred and non-preferred stimuli in the four groups in either of the two

experiments. Future research should use a complementary measurement to time to first fixation (for example, the number of first fixations to an area of interest) because time to first fixation does not guarantee that the times measured correspond to an automatic process, and because it is necessary to exhaustively control that the first fixation is on the central point, which can lead to the exclusion of a large amount of data. Thus, we suggest that time to first fixation on specific areas should be considered as an indicator of early attention, but not necessarily of automatic processes.

Participants were excluded if they reported any sexual fantasies about children or if they endorsed more than one cognition about children and sex, but we cannot be assured that all participants had no paedophilic sexual interests, because some participants might have lied. Future research could further screen for paedophilic interests by including additional assessment information (e.g., phallometric testing of sexual arousal to children). Any presence of paedophilic participants would be expected to obscure group differences and other effects for manipulations involving target age.

Another limitation of our study is that we included predominantly heterosexual women in our androphilic women group, because Chivers, Bouchard and Timmers (2015) found that gender non-specificity was observed only in exclusively androphilic women. However, only one female participant rated herself as predominantly heterosexual on the Kinsey Scale, so this potential confound was minimal.

Finally, our results support the non-specificity of early attention in androphilic women towards non-erotic stimuli without prepotent sexual features. Our results might have been different if more intense sexual stimuli were used; this could have made it more challenging for participants to ascertain sexual development and age because important areas are covered, which could have artificially increased attention to these areas

compared to what would be visible if they had been nude. Prior studies have shown that specificity can be affected by features such as the presence of prepotent stimuli (exposed and aroused genitals: Spape et al., 2014) and manipulation of sexual activity (e.g. preferred vs non-preferred sexual activities: Chivers et al., 2015). Future studies could use other stimulus sets to see if group differences and similarities in patterns of early and late attention we observed are affected.

3.7 Supplementary Results

3.7.1 Experiment 1

Time to First Fixation (TFF)

Table S1.
Descriptive statistics for time for first fixation (TFF). according to target gender and age.

Area of interest (AOI)		Target							
		Male				Female			
		Adult		Child		Adult		Child	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Male Participants									
Body	Gyn.	1.35	0.52	1.23	0.32	0.99	0.24	1.05	0.21
	And.	0.90	0.26	0.98	0.31	1.60	0.42	1.18	0.28
Face	Gyn.	1.71	0.62	1.45	0.50	1.45	0.46	1.29	0.41
	And.	1.30	0.44	1.04	0.34	1.84	0.59	1.44	0.40
Chest	Gyn.	1.60	0.68	1.73	0.68	1.73	0.38	1.66	0.48
	And.	1.59	0.49	1.87	0.39	2.24	0.66	1.71	0.40
Pelvis	Gyn.	2.33	1.16	2.27	0.63	2.25	0.38	2.59	0.77
	And.	2.08	0.55	1.92	0.57	2.79	0.81	2.52	0.66
Female Participants									
Body	Gyn.	1.46	0.60	1.31	0.35	1.02	0.27	0.86	0.18
	And.	1.21	0.30	1.26	0.30	1.19	0.35	1.05	0.23
Face	Gyn.	1.86	0.65	1.57	0.52	1.58	0.39	1.18	0.22
	And.	1.59	0.46	1.51	0.49	1.52	0.35	1.4	0.4
Chest	Gyn.	1.81	0.65	1.84	0.56	1.65	0.32	1.53	0.45
	And.	1.79	0.37	2	0.48	1.64	0.44	1.55	0.43
Pelvis	Gyn.	2.17	0.78	2.22	0.73	2.18	0.33	1.91	0.76
	And.	2.48	0.48	2.38	0.72	2.26	0.6	2.27	0.71

And. = Androphilic participants. Gyn. = Gynephilic participants.

Table S2.
Time to first fixation (TFF): post-hoc comparison target gender and age for each participant group.

Area of Interest (AOI)		Participants											
		Male						Female					
		Gynephilic			Androphilic			Gynephilic			Androphilic		
		F	d.f.	*p*	*F*	d.f.	*p*	*F*	d.f.	*p*	*F*	d.f.	*p*
Body	TG	**10.73**	**1, 33**	**.002**	**41.67**	**1, 22**	**<.001**	**12.47**	**1, 16**	**.003**	5.68	1, 24	.025
	TA	1.00	1, 33	.324	**9.98**	**1, 22**	**.005**	3.66	1, 16	.074	0.88	1, 24	.358
	TG*TA	1.64	1, 33	.209	**18.17**	**1, 22**	**<.001**	0.26	1, 16	.615	2.89	1, 24	.102
Face	TG	5.92	1, 32	.021	**31.28**	**1, 21**	**<.001**	5.39	1, 16	.034	1.74	1, 23	.200
	TA	**8.61**	**1, 32**	**.006**	**20.92**	**1, 21**	**<.001**	**20.04**	**1, 16**	**<.001**	1.49	1, 23	.235
	TG*TA	0.47	1, 32	.496	3.69	1, 21	.068	0.54	1, 16	.471	0.11	1, 23	.740
Chest	TG	0.10	1, 33	.759	5.21	1, 22	.033	2.57	1, 16	.128	**18.76**	**1, 24**	**<.001**
	TA	0.18	1, 33	.671	2.95	1, 22	.100	0.41	1, 16	.533	0.73	1, 24	.402
	TG*TA	1.65	1, 33	.208	**16.65**	**1, 22**	**<.001**	0.61	1, 16	.447	3.45	1, 24	.075
Pelvis	TG	0.77	1, 31	.387	**17.79**	**1, 19**	**<.001**	1.21	1, 16	.288	1.53	1, 24	.229
	TA	0.92	1, 31	.345	4.55	1, 19	.046	0.84	1, 16	.374	0.17	1, 24	.683
	TG*TA	2.05	1, 31	.162	0.02	1, 19	.888	0.63	1, 16	.438	0.24	1, 24	.631

Results are from repeated-measures GLMs for each area of interest (AOI) and participant group, showing main effects of Target Gender (TG) and Target Age (TA), and their interaction, for time to first fixation (TFF). Significant effects are in bold.

Table S3.
Time to first fixation (TFF): post-hoc comparison of male versus female targets.

Area of Interest (AOI)		Participants											
		Male						Female					
		Gynephilic			Androphilic			Gynephilic			Androphilic		
		t	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*
Body	AT	2.63	33	.013	**-6.29**	**22**	**<.001**	-3.31	22	<.001	0.55	24	.586
	CT	2.22	33	.033	2.42	16	.028	4.62	16	<.001	**3.83**	**24**	**<.001**
Face	AT	1.80	32	.082	**-4.25**	**21**	**<.001**	1.49	16	.155	0.77	23	.447
	CT	2.40	32	.022	**-4.11**	**22**	**<.001**	3.01	16	<.01	1.21	24	.239
Chest	AT	-1.06	33	.296	**-3.87**	**22**	**<.001**	0.87	16	.397	1.34	24	.193
	CT	0.60	33	.551	1.40	22	.176	1.92	16	.072	**4.55**	**24**	**<.001**
Pelvis	AT	0.34	32	.737	**-2.94**	**21**	**<.01**	-0.06	16	.954	1.39	24	.177
	CT	-1.79	31	.083	**-5.93**	**20**	**<.001**	1.21	16	.245	0.53	24	.604

Results are from paired-samples *t*-tests for each area of interest (AOI). comparing time to first fixation (TFF) to male versus female targets when viewing adult targets (AT) or child targets (CT). Significant effects are in bold.

Total Duration of Fixation (TDF)

Table S4.
Descriptive statistics for total duration of fixation (TDF). according to target gender and age.

Area of interest (AOI)		Target							
		Male				Female			
		Adult		Child		Adult		Child	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Male Participants									
Body	Gyn.	0.99	0.51	1.25	0.41	2.49	0.58	1.64	0.46
	And.	2.44	0.86	1.38	0.55	0.94	0.47	1.37	0.54
Face	Gyn.	0.29	0.21	0.54	0.34	0.62	0.41	0.66	0.39
	And.	0.70	0.43	0.67	0.36	0.37	0.21	0.65	0.39
Chest	Gyn.	0.25	0.19	0.16	0.10	0.45	0.18	0.20	0.11
	And.	0.49	0.20	0.13	0.09	0.14	0.11	0.15	0.08
Pelvis	Gyn.	0.1	0.1	0.09	0.07	0.46	0.21	0.08	0.1
	And.	0.37	0.27	0.12	0.12	0.1	0.09	0.06	0.06
Female Participants									
Body	Gyn.	1.11	0.36	1.35	0.44	2.67	0.58	1.89	0.68
	And.	2.18	0.70	1.32	0.49	1.11	0.47	1.40	0.48
Face	Gyn.	0.32	0.19	0.57	0.34	0.66	0.34	0.80	0.43
	And.	0.62	0.38	0.66	0.46	0.32	0.23	0.62	0.39
Chest	Gyn.	0.24	0.10	0.15	0.11	0.49	0.23	0.27	0.15
	And.	0.46	0.18	0.13	0.09	0.22	0.15	0.19	0.1
Pelvis	Gyn.	0.13	0.06	0.13	0.09	0.57	0.21	0.14	0.14
	And.	0.29	0.16	0.1	0.08	0.19	0.1	0.07	0.05

And. = Androphilic participants. Gyn. = Gynephilic participants.

Table S5.
Total duration of fixation (TDF): post-hoc comparison target gender and age for each participant group.

Area of Interest (AOI)		Participants											
		Male						Female					
		Gynephilic			Androphilic			Gynephilic			Androphilic		
		F	d.f.	*p*	*F*	d.f.	*p*	*F*	d.f.	*p*	*F*	d.f.	*p*
Body	TG	**48.71**	**1, 33**	**<.001**	**30.39**	**1, 22**	**<.001**	**32.43**	**1, 16**	**<.001**	**21.67**	**1, 24**	**<.001**
	TA	**39.79**	**1, 33**	**<.001**	**35.10**	**1, 22**	**<.001**	**10.67**	**1, 16**	**.005**	**21.25**	**1, 24**	**<.001**
	TG*TA	**46.64**	**1, 33**	**<.001**	**39.82**	**1, 22**	**<.001**	**27.50**	**1, 16**	**<.001**	**62.43**	**1, 24**	**<.001**
Face	TG	**25.21**	**1, 33**	**<.001**	**17.76**	**1, 22**	**<.001**	**12.66**	**1, 16**	**.003**	**18.52**	**1, 24**	**<.001**
	TA	**22.06**	**1, 33**	**<.001**	4.86	1, 22	.038	**18.51**	**1, 16**	**<.001**	**13.37**	**1, 24**	**.001**
	TG*TA	**9.25**	**1, 33**	**.005**	**8.32**	**1, 22**	**.009**	2.66	1, 16	.122	**26.76**	**1, 24**	**<.001**
Chest	TG	**19.47**	**1, 33**	**<.001**	**39.13**	**1, 22**	**<.001**	**17.90**	**1, 16**	**<.001**	**16.90**	**1, 24**	**<.001**
	TA	**55.87**	**1, 33**	**<.001**	**90.41**	**1, 22**	**<.001**	**20.34**	**1, 16**	**<.001**	**92.24**	**1, 24**	**<.001**
	TG*TA	**10.24**	**1, 33**	**<.001**	**71.76**	**1, 22**	**<.001**	5.05	1, 16	.039	**59.68**	**1, 24**	**<.001**
Pelvis	TG	**42.51**	**1, 33**	**<.001**	**17.87**	**1, 22**	**<.001**	**35.25**	**1, 16**	**<.001**	**13.04**	**1, 24**	**.001**
	TA	**160.73**	**1, 33**	**<.001**	**51.83**	**1, 22**	**<.001**	**45.34**	**1, 16**	**<.001**	**70.96**	**1, 24**	**<.001**
	TG*TA	**77.34**	**1, 33**	**<.001**	**15.42**	**1, 22**	**<.001**	**70.67**	**1, 16**	**<.001**	3.53	1, 24	.072

Results are from repeated-measures GLMs for each area of interest (AOI) and participant group, showing main effects of Target Gender (TG) and Target Age (TA), and their interaction, for total duration of fixation (TDF). Significant effects are in bold.

Table S6.
Total duration of fixation (TDF): post-hoc comparison of male versus female targets.

Area of Interest (AOI)		Participants											
		Male						Female					
		Gynephilic			Androphilic			Gynephilic			Androphilic		
		t	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*
Body	AT	**-7.65**	**33**	**<.001**	**6.42**	**22**	**<.001**	**-7.40**	**16**	**<.001**	**6.31**	**24**	**<.001**
	CT	**-3.09**	**33**	**.004**	0.20	22	.842	**-2.91**	**16**	**.010**	-1.65	24	.112
Face	AT	**-5.27**	**33**	**<.001**	**3.86**	**22**	**<.001**	**-4.58**	**16**	**<.001**	**5.45**	**24**	**<.001**
	CT	-2.31	33	.027	0.38	22	.708	-2.29	16	.036	1.19	24	.247
Chest	AT	**-4.01**	**33**	**<.001**	**7.56**	**22**	**<.001**	**-3.64**	**16**	**<.01**	**6.05**	**24**	**<.001**
	CT	-2.27	33	.030	-0.97	22	.343	**-3.98**	**16**	**<.01**	**-5.14**	**24**	**<.001**
Pelvis	AT	**-7.84**	**33**	**<.001**	**4.32**	**22**	**<.001**	**-7.87**	**16**	**<.001**	**3.02**	**24**	**<.01**
	CT	0.16	33	.874	2.33	22	.029	-0.27	16	.792	2.38	24	.026

Results are from paired-samples *t*-tests for each area of interest (AOI). comparing total duration of fixation (TDF) to male versus female targets when viewing adult targets (AT) or child targets (CT). Significant effects are in bold.

3.7.2 Experiment 2

Time to First Fixation (TFF)

Table S7.
Descriptive statistics for time for first fixation (TFF). according to target gender and age.

Area of interest (AOI)		Target							
		Male				Female			
		Adult		Child		Adult		Child	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Male Participants									
Body	Gyn.	1.002	0.29	1.21	0.41	0.98	0.25	1.07	0.43
	And.	0.88	0.41	1.09	0.71	1.02	0.29	1.17	0.58
Face	Gyn.	1.25	0.42	1.36	0.56	1.39	0.56	1.37	0.63
	And.	1.44	0.59	1.43	0.71	1.35	0.49	1.50	0.79
Chest	Gyn.	1.44	0.45	1.66	0.83	1.80	0.33	1.36	0.58
	And.	1.58	0.45	1.21	0.82	1.75	0.39	1.43	0.55
Pelvis	Gyn.	2.58	0.88	2.32	0.91	2.17	0.4	2.73	1.26
	And.	2.17	0.54	2.28	1.07	2.23	0.51	2.48	1.03
Female Participants									
Body	Gyn.	1.07	0.27	1.26	0.43	1.05	0.25	1.1	0.47
	And.	1.07	0.26	1.15	0.47	0.98	0.25	1.14	0.3
Face	Gyn.	1.56	0.48	1.54	0.44	1.44	0.52	1.28	0.52
	And.	1.51	0.43	1.52	0.53	1.56	0.58	1.49	0.44
Chest	Gyn.	1.55	0.39	1.88	0.56	1.82	0.24	1.42	0.59
	And.	1.64	0.39	1.49	0.7	1.69	0.51	1.79	0.45
Pelvis	Gyn.	2.21	0.5	2.11	0.89	2.18	0.51	2.53	0.98
	And.	2.42	0.54	2.15	0.85	2.01	0.47	2.67	0.83

And. = Androphilic participants. Gyn. = Gynephilic participants.

Table S8.
Time to first fixation (TFF): post-hoc comparison target age and gender for each participant group.

Area of Interest (AOI)		Participants											
		Male						Female					
		Gynephilic			Androphilic			Gynephilic			Androphilic		
		F	d.f.	*p*	*F*	d.f.	*p*	*F*	d.f.	*p*	*F*	d.f.	*p*
Body	TA	3.93	1, 31	.056	3.89	1, 22	.061	1.56	1, 17	.228	3.91	1, 24	.060
	TG	1.96	1, 31	.171	3.70	1, 22	.067	5.34	1, 17	.034	0.68	1, 24	.416
	TA*TG	2.39	1, 31	.133	0.21	1, 22	.651	1.60	1, 17	.223	0.42	1, 24	.525
Face	TA	0.03	1, 30	.875	0.02	1, 20	.882	0.46	1, 17	.508	0.11	1, 24	.745
	TG	2.25	1, 30	.144	0.01	1, 20	.907	5.26	1, 17	.035	0.03	1, 24	.861
	TA*TG	0.65	1, 30	.426	2.18	1, 20	.156	0.95	1, 17	.343	0.28	1, 24	.599
Chest	TA	0.76	1, 29	.392	7.01	1, 21	.015	0.02	1, 16	.880	0.11	1, 24	.740
	TG	0.68	1, 29	.415	4.14	1, 21	.055	0.46	1, 16	.507	2.64	1, 24	.117
	TA*TG	**14.57**	**1, 29**	**<.001**	0.01	1, 21	.906	6.78	1, 16	.019	1.46	1, 24	.239
Pelvis	TA	2.49	1, 18	.132	4.46	1, 16	.051	0.98	1, 14	.339	2.66	1, 16	.123
	TG	1.01	1, 18	.328	0.18	1, 16	.676	0.29	1, 14	.601	2.09	1, 16	.167
	TA*TG	6.26	1, 18	.022	0.05	1, 16	.828	0.87	1, 14	.365	**12.09**	**1, 16**	**.003**

Results are from repeated-measures GLMs for each area of interest (AOI) and participant group, showing main effects of Target Age (TA) and Target Gender (TG), and their interaction, for time to first fixation (TFF). Significant effects are in bold.

Table S9.
Time to first fixation (TFF): post-hoc comparison of adult versus child targets.

Area of Interest (AOI)		Participants											
		Male						Female					
		Gynephilic			Androphilic			Gynephilic			Androphilic		
		t	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*
Body	MT	-2.45	31	.020	-1.51	22	.145	-1.58	17	.132	-0.93	24	.363
	FT	-0.84	31	.409	-1.66	22	.110	-0.69	17	.502	-2.46	24	.021
Face	MT	-1.10	31	.278	0.10	21	.920	0.15	17	.885	-0.13	24	.898
	FT	0.39	30	.698	-1.15	21	.262	1.00	17	.333	0.52	24	.607
Chest	MT	-1.51	30	.142	1.93	21	.068	-1.97	16	.067	0.99	24	.331
	FT	**3.52**	**30**	**.001**	2.35	21	.028	2.53	17	.022	-0.92	24	.368
Pelvis	MT	0.69	23	.499	-0.75	17	.462	0.34	16	.741	1.35	18	.195
	FT	-1.86	22	.077	-1.20	17	.248	-1.33	14	.206	**-3.70**	**19**	**.002**

Results are from paired-samples *t*-tests for each area of interest (AOI). comparing total duration of fixation (TDF) to adult versus child targets in male targets (MT) and female targets (FT). Significant effects are in bold.

Total Duration of Fixation (TDF)

Table S10.
Descriptive statistics for total fixation duration (TDF). according to target gender and age.

Area of interest (AOI)		Target							
		Male				Female			
		Adult		Child		Adult		Child	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Male Participants									
Body	Gyn.	1.96	0.97	0.95	0.53	2.68	0.67	0.65	0.35
	And.	2.82	0.77	0.50	0.39	2.12	0.74	0.76	0.48
Face	Gyn.	0.10	0.10	0.05	0.05	0.44	0.22	0.02	0.03
	And.	0.31	0.24	0.04	0.04	0.25	0.13	0.02	0.02
Chest	Gyn.	0.47	0.40	0.10	0.07	0.47	0.20	0.08	0.06
	And.	0.54	0.22	0.08	0.07	0.35	0.20	0.10	0.07
Pelvis	Gyn.	0.6	0.36	0.49	0.37	0.65	0.4	0.3	0.21
	And.	0.83	0.6	0.22	0.21	0.68	0.54	0.32	0.33
Female Participants									
Body	Gyn.	2.27	0.71	1.02	0.49	2.68	0.69	0.78	0.42
	And.	2.34	0.70	0.66	0.54	1.71	0.56	1.10	0.53
Face	Gyn.	0.23	0.21	0.09	0.07	0.50	0.23	0.04	0.04
	And.	0.23	0.15	0.04	0.04	0.26	0.18	0.03	0.03
Chest	Gyn.	0.47	0.24	0.10	0.06	0.44	0.20	0.09	0.06
	And.	0.49	0.2	0.07	0.07	0.3	0.14	0.15	0.09
Pelvis	Gyn.	0.82	0.5	0.51	0.39	0.69	0.33	0.3	0.21
	And.	0.65	0.4	0.33	0.4	0.44	0.41	0.47	0.43

And. = Androphilic participants. Gyn. = Gynephilic participants.

Table S11.
Total duration of fixation (TDF): post-hoc comparison target age and gender for each participant group.

Area of Interest (AOI)		Participants											
		Male						Female					
		Gynephilic			Androphilic			Gynephilic			Androphilic		
		F	d.f.	*p*	*F*	d.f.	*p*	*F*	d.f.	*p*	*F*	d.f.	*p*
Body	TA	**107.13**	**1, 31**	**<.001**	**141.20**	**1, 22**	**<.001**	**52.54**	**1, 17**	**<.001**	**57.13**	**1, 24**	**<.001**
	TG	**8.58**	**1, 31**	**.006**	**16.06**	**1, 22**	**<.001**	4.44	1, 17	.050	4.98	1, 24	.035
	TA*TG	**18.90**	**1, 31**	**<.001**	**22.76**	**1, 22**	**<.001**	**9.84**	**1, 17**	**.006**	**41.34**	**1, 24**	**<.001**
Face	TA	**14.78**	**1, 31**	**<.001**	**18.85**	**1, 22**	**<.001**	**12.56**	**1, 17**	**.002**	3.40	1, 24	.078
	TG	4.96	1, 31	.033	0.34	1, 22	.567	**8.92**	**1, 17**	**.008**	0.65	1, 24	.428
	TA*TG	**14.93**	**1, 31**	**<.001**	**15.13**	**1, 22**	**<.001**	0.72	1, 17	.407	**37.29**	**1, 24**	**<.001**
Chest	TA	**83.88**	**1, 31**	**<.001**	**97.12**	**1, 22**	**<.001**	**50.44**	**1, 17**	**<.001**	**125.93**	**1, 24**	**<.001**
	TG	0.09	1, 31	.770	**15.15**	**1, 22**	**<.001**	0.52	1, 17	.480	**7.50**	**1, 24**	**.011**
	TA*TG	0.11	1, 31	.739	**23.29**	**1, 22**	**<.001**	0.22	1, 17	.644	**32.55**	**1, 24**	**<.001**
Pelvis	TA	**137.86**	**1, 31**	**<.001**	**65.32**	**1, 22**	**<.001**	**43.40**	**1, 17**	**<.001**	**65.90**	**1, 24**	**<.001**
	TG	**46.26**	**1, 31**	**<.001**	2.91	1, 22	.102	**29.50**	**1, 17**	**<.001**	0.47	1, 24	.500
	TA*TG	**73.73**	**1, 31**	**<.001**	0.80	1, 22	.379	**68.12**	**1, 17**	**<.001**	0.68	1, 24	.419

Results are from repeated-measures GLMs for each area of interest (AOI) and participant group, showing main effects of Target Age (TA) and Target Gender (TG), and their interaction, for total duration of fixation (TDF). Significant effects are in bold.

Table S12.
Total fixation duration (TDF): post-hoc comparison of adult versus child targets.

Area of Interest (AOI)		Participants											
		Male						Female					
		Gynephilic			Androphilic			Gynephilic			Androphilic		
		t	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*
Body	MT	**4.86**	**31**	**<.001**	**12.15**	**22**	**<.001**	**5.10**	**17**	**<.001**	**8.60**	**24**	**<.001**
	FT	**13.82**	**31**	**<.001**	**7.74**	**22**	**<.001**	**8.17**	**17**	**<.001**	**4.15**	**24**	**<.001**
Face	MT	**5.31**	**31**	**<.001**	**9.71**	**22**	**<.001**	**10.22**	**24**	**<.001**	**6.09**	**17**	**<.001**
	FT	**10.88**	**31**	**<.001**	**6.61**	**22**	**<.001**	**5.45**	**24**	**<.001**	**6.35**	**17**	**<.001**
Chest	MT	**3.05**	**31**	**<.01**	**5.48**	**22**	**<.001**	**6.02**	**24**	**<.001**	**2.99**	**17**	**<.01**
	FT	**10.97**	**31**	**<.001**	**8.81**	**22**	**<.001**	**6.58**	**24**	**<.001**	**8.79**	**17**	**<.001**
Pelvis	MT	1.55	31	.130	**4.99**	**22**	**<.001**	**3.28**	**24**	**<.01**	2.50	17	.020
	FT	**5.28**	**31**	**<.001**	**3.25**	**22**	**<.01**	-0.38	24	.710	**4.42**	**17**	**<.001**

Results are from paired-samples *t*-tests for each area of interest (AOI). comparing total duration of fixation (TDF) to adult versus child targets when viewing male targets (MT) or female targets (FT). Significant effects are in bold.

Subjective Sexual Attraction

Table S13
Descriptive statistics for Subjective valence and sexual arousal.

		Target							
		Male				Female			
		Adult		Child		Adult		Child	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Male Participants									
Valence	Gyn.	4.12	1.69	3.72	1.91	7.14	1.38	4.21	1.90
	And.	7.42	1.16	3.26	1.75	5.10	1.71	3.21	1.71
Arousal	Gyn.	1.52	1.54	1.69	1.51	5.63	1.84	1.54	1.54
	And.	6.11	2.09	1.45	0.50	2.38	1.38	1.18	0.49
Valence	Gyn.	4.47	2.02	3.55	2.12	7.07	1.13	3.66	1.90
	And.	7.05	0.94	3.97	1.89	4.56	1.44	3.96	1.87
Arousal	Gyn.	2.27	1.50	1.29	0.71	5.47	1.71	1.18	0.78
	And.	4.50	2.09	1.26	0.27	1.47	1.00	1.06	0.35

Gyn. = Gynephilic participants; And. = Androphilic participants.

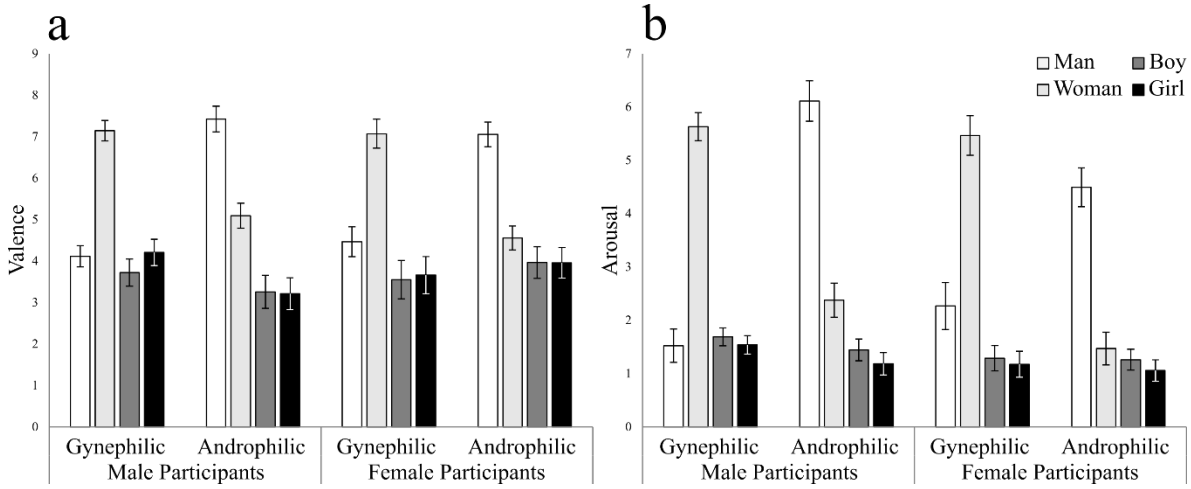

Figure S1. Subjective Sexual Attraction (a) Valence; (b) Arousal; split by stimuli target (male targets: white bars; female targets: light grey bars; boy targets: dark grey bars; girl targets: black bars). Bars represent estimated marginal means ± 1 S.E.M.

CAPÍTULO 4. ESTUDIO 2. NO RELATION BETWEEN DIGIT RATIO (2D:4D) AND VISUAL ATTENTION PATTERNS TO SEXUALLY PREFERRED AND NON-PREFERRED STIMULI

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4.1 Abstract

Digit ratio (2D:4D) is a marker of prenatal androgenic exposure that is correlated with different behaviour patterns. Here, we explore the relationship between 2D:4D ratio and early versus late attention to sexually preferred stimuli using an eye-tracking paradigm with 78 androphilic or gynephilic men and women. We simultaneously presented preferred and non-preferred adult stimuli and assessed visual attention across time to first fixation and total duration fixation on entire body and three specific areas (face, chest and pelvis), and investigated whether digit ratio was related to visual attentional biases towards sexually preferred stimuli. As expected, participants tended to fixate faster and for more time on the preferred gender. However, we found no significant interactions between 2D:4D and attentional biases towards the preferred gender, for any measure of attention. These results suggest that attention towards the preferred gender is not related to the 2D:4D digit ratio.

4.2 Introduction

4.2.1 Digit Ratio

The ratio between index (2D) and annular (4D) finger lengths (Brown, Finn, & Breedlove, 2002), has been considered as an indirect indicator of prenatal androgen exposure that is relevant to the masculinization of brain structures and behaviour (Hönekopp & Bartholdt, 2007; Manning, 2011; Manning, Churchill, & Peters, 2007; van Honk et al., 2011). Although the mechanisms underlying the influence of androgens on finger growth are still unclear, recent evidence shows that androgens and oestrogens differentially regulate the network of genes that control the proliferation of chondrocytes, leading to differential growth of the fourth digit in males and females (Zheng & Cohn, 2011). Experimentally inactivating androgen receptors in monkeys decreases 4D growth, causing higher 2D:4D ratios, while inactivation of oestrogen receptors increases 4D growth, leading to lower 2D:4D ratios. These results suggest that 2D:4D ratio could be a stable indicator of prenatal hormonal exposure (Zheng & Cohn, 2011).

The 2D:4D ratio is lower in men than in women. In their meta-analysis of gender differences in 2D:4D ratio, Hönekopp and Watson, (2010) found a moderate gender difference, with considerable heterogeneity (possibly driven by soft tissue differences) that was moderated by type of finger length measurement (direct measurements and measurements from radiographs results in smaller gender differences than indirect measurements) and hand measured (a larger gender difference in the right hand).

The 2D:4D ratio is correlated with other variables as cognitive abilities, aggression, or dominant personality (Alexander & Son, 2007; Barel & Tzischinsky, 2017; van der Meij et al., 2012). Recently, Turanovic, Pratt, and Piquero (2017) found an

association between 2D:4D digit ratio and aggression in their meta-analysis, with a weak but statistically significant effect size across a variety of methodological conditions (measures, kinds of samples).

However, some empirical studies suggest that 2D:4D ratio is not a reliable indicator of prenatal testosterone action (Hampson & Sankar, 2012; Voracek, 2014; Zhang et al., 2013). Based on the neuroandrogenic theory put forward by Ellis and Ames (1987), it has been suggested that an unbalanced exposure to prenatal androgens would increase the likelihood of homosexuality in men and women, because both homosexual men and women had experienced significantly higher levels of perinatal androgen that heterosexual men and women (Brown, Finn, Cooke, & Breedlove, 2002; Williams et al., 2000). However, evidence for an association between 2D:4D ratio and sexual orientation has shown mixed results. Results are mixed for men (e.g. Kangassalo, Pölkki, & Rantala, 2011; Xu & Zheng, 2016), and indeed Grimbos, Dawood, Burriss, Zucker and Puts, (2010) found significant association between sexual orientation and 2D:4D ratio for women only in their meta-analysis, with a larger effect size for the right versus left hand.

Less research is available on sexual preference and behaviour. These studies suggest low 2D:4D ratios are associated with increased sexual jealousy in men (Bendixen et al., 2015), higher reproductive success in men (Klimek, Galbarczyk, Nenko, Alvarado, & Jasienska, 2014; Manning & Fink, 2008) and lower reproductive success in women (Manning & Fink, 2008), sexually attractive facial characteristics in men (Ferdenzi, Lemaître, Leongómez, & Roberts, 2011), more interest in short- versus long-term sexual relationships and number of sex partners in men (Honekopp, Voracek, & Manning, 2006; Schwarz, Mustafić, Hassebrauck, & Jörg, 2011), and greater erotic gift-giving to female romantic partners (Nepomuceno, Saad, Stenstrom, Mendenhall, & Iglesias, 2016). There

are no studies investigating the association between 2D:4D ratio and sexual preferences and behaviour in homosexual people.

4.2.2 Visual Attention

Research using eye-tracking and pupillometry techniques has found that visual attention prioritizes sexually attractive stimuli and areas of interest (Dixson, Grimshaw, Linklater, & Dixson, 2011; Hewig, Trippe, Hecht, Straube, & Miltner, 2008; Lykins, Meana, & Strauss, 2008). Fromberger et al. (2012, 2013) found that heterosexual men who sexually preferred adults, looked at stimuli depicting women faster and longer than non-preferred stimuli (men or children of either gender). Similar results have been found in homosexual men and women, who are more influenced by the presence of sexually dimorphic, attractive physical characteristics of the preferred sex, than heterosexual women, who show a non-specific response in their sexual preferences (Dawson & Chivers, 2016; Dawson et al., 2016; Hewig et al., 2008; Rieger & Savin-Williams, 2012; Samson & Janssen, 2014).

It is assumed that when there is sexual interest, attention will be focused more on the body than on the face, given reproductive signals such as chest-to-waist ratio in men and waist-to-hip ratio in women (Bolmont, Cacioppo, & Cacioppo, 2014; Lykins, Meana, & Kambe, 2006; Lykins et al., 2008). These body signals could be influenced by variations in prenatal testosterone levels. Huh (2013), in a study about attention allocation in which participants selected whether to uncover the face or the body of stimuli, did not find significant differences in the 2D:4D ratios of 64 men and 45 women, but did find that people who chose to view the body of an opposite-gender target had significantly lower ratios than those who chose the face. Thus, a low 2D:4D ratio, regardless of participant gender, could be associated with greater attention to bodies than to faces.

However, there are no studies using eye-tracking to test the association between 2D:4D ratios and visual attention responses to sexually preferred stimuli, aside from Strong (2014), who found no association between digit ratio and more attention towards opposite-gender stimuli in a sample of 25 men and 45 women.

4.2.3 The Present Study

In the present study, we explore gender and sexual orientation differences in 2D:4D ratio, and the relationship between the 2D:4D ratio and early versus late attention to sexually preferred stimuli in an eye-tracking paradigm. Chivers (2017), based on previous findings (Dawson & Chivers, 2016; Hamann et al., 2014), hypothesised that lower prenatal androgenisation could be related to non-specific response patterns in terms of preferred gender, whereas greater prenatal androgenisation would be associated with greater gender-specific response. Therefore, we predicted that men and women of any sexual orientation with low (more masculinized) 2D:4D ratios would fixate faster (initial orientation) and longer (late attention) on bodies, and especially sexual areas (face, chest and pelvis) of sexually preferred stimuli than men and women with high ratios.

4.3 Methods

4.3.1 Participants

Data were extracted from a larger study involving two experiments on the identification of sexual preferences through patterns of visual attention. The present sample consisted of 78 men and women (mean age ± SD = 19.54 ± 1.24 years old), divided into 4 groups: 23 gynephilic men (21.13 ± 2.55), 21 androphilic women (19.14 ± 1.08), 18 androphilic men (20.44 ± 1.73), and 16 gynephilic women (20.06 ± 1.24).

Sexual orientation was classified using the Kinsey scale (Kinsey, Pomeroy, & Martin, 2003; Krogman, 1948), and only individuals who scored 0 or 1 (exclusively or mainly heterosexual), and 5 or 6 (mainly or exclusively homosexual) took part in the study. To avoid inaccuracies in the calculation of the 2D:4D ratio, participants were selected from an initial pool of 119 students, after excluding those who were left handed, reported fractures or dislocations of the index or ring fingers, as well as those who, for diverse reasons (calibration, loss of attention, or somnolence), presented a sampling of eye movements of less than 85% of trials.

4.3.2 Measures and procedure

All procedures obtained approval from the Institutional Ethics Committee. Students were invited to participate voluntarily and the study procedure was explained. Those who agreed to participate provided written informed consent and completed a series of questionnaires that included sociodemographic data, the Kinsey scale (1948) for the identification of sexual orientation, and an evaluation of psychosomatic symptoms (Sandín, Valiente, Chorot, Santed, & Lostao, 2008) to rule out psychological or psychiatric symptoms (e.g. depression, psychotic symptoms at the time of the study). The experimental phase only included students who completed the questionnaires and met all the criteria (n = 78), and included eye-tracking data, subjective valence and arousal ratings of all stimuli, and hand scanner to measure 2D:4D ratios. For a detailed description of eye movement data collection, subjective sexual attractive measurements, and 2D:4D ratio measurement techniques, see the Supplementary Materials.

4.3.3 Statistical Analyses

To identify fixations, the Tobii Fixation Filter was used, which filters out saccadic movements. The dispersion threshold for fixations was 30 pixels, with a minimum duration of 100ms. Following Dawson and Chivers (2016), if the speed was kept below this threshold, the data were assigned to the same fixation. Time to first fixation is the latency of first fixation for each area of interest (Hewig et al., 2008), and it is considered a valid measure of early attention (Dawson & Chivers, 2016). Total duration fixation and fixation count are indices of later attention, and they correspond to the mean total amount of time spent looking at a specific stimulus region and the mean total number of fixations on a specific region, respectively (Dawson & Chivers, 2016; Lykins et al., 2006; Mitrovic, Tinio, & Leder, 2016). Each stimulus was divided into four areas of interest: Entire body, then face (non-erotic area), chest, and pelvis (erotic areas) (Hall, Hogue, & Guo, 2011; Hewig et al., 2008; Suschinsky, Elias, & Krupp, 2007). We also examined subjective reports of valence and arousal. For a detailed description of statistical analyses, see the Supplementary Materials.

4.4 Results

Descriptive statistics for each dependent variable – time to first fixation, total duration of fixation, fixation count, subjective valence, and subjective arousal – as well as the 2D:4D ratios, are reported in Table 1.

Differences in the 2D:4D ratio by gender and/or sexual orientation were analysed using a 2x2 general linear model, which showed that men have lower ratios than women ($F_{1, 74}$ = 10.12, p = .002; Table 1), but there were no significant differences between androphilic and gynephilic participants ($F_{1, 74}$ = 0.13, p = .72; Table 1), and no

significant interaction between the gender and sexual orientation of the participants ($F_{1, 74} = 0.17$, $p = .68$; Fig. 1).

As expected, the main analyses using mixed models showed a significant main effect of target gender, where participants, regardless of their gender and sexual orientation, tended to fixate faster on the body and face (but not on the chest or pelvis) of the preferred gender. They tended to fixate for a longer total time, and for more times, on all the areas of interest for preferred targets, and they showed increased valence and arousal towards preferred targets when compared to non-preferred targets (Table 2).

In addition, there were several significant interactions with target gender, including one interaction between target and participant gender for time to first fixation towards the face: Men looked at the face of preferred targets faster than the face of non-preferred targets, whereas this difference was not found in women. Similarly, for time to first fixation, there were interactions between target gender and participant sexual orientation for the body and chest: androphilic men and gynephilic women, but not gynephilic men or androphilic women, showed significantly shorter times to first fixation towards the body and chest of preferred targets compared to non-preferred targets (Table 2). For total duration of fixation (pelvis) and fixation count (chest and pelvis), there were significant interactions between target gender, participant gender, and participant sexual orientation: In all these cases, gynephilic or androphilic men and gynephilic women showed longer total fixation times towards the pelvis and more fixations towards the chest and pelvis of preferred versus non-preferred targets, whereas these differences were not found with androphilic women (Table 2).

The interaction between target gender and the covariate (2D:4D) was not significant, suggesting that attention towards the preferred gender is not related to the

2D:4D digit ratio (Table 2). To explore this question, we performed correlations between 2D:4D and the difference (preferred – non-preferred) scores (Fig. 2). These analyses show the lack of relationship between the 2D:4D digit ratio and the strength of preferences towards targets of the preferred gender.

Table 1. *Mean values ± SD for measured dependent variables towards targets of the preferred and non-preferred gender.*

	Women				**Men**				**All (*n* = 78)**			
	And. (*n* = 21)		**Gyn. (*n* = 16)**		**And. (*n* = 18)**		**Gyn. (*n* = 23)**					
Time to First Fixation (TFF)												
	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.		
Body	1,20 ± 0,31	1,18 ± 0,36	1,02 ± 0,27	1,46 ± 0,60	0,89 ± 0,28	1,54 ± 0,38	1,02 ± 0,24	1,40 ± 0,54	1,04 ± 0,29	1,39 ± 0,49		
Face	1,57 ± 0,49	1,53 ± 0,37	1,56 ± 0,39	1,87 ± 0,66	1,19 ± 0,32	1,76 ± 0,53	1,31 ± 0,35	1,76 ± 0,60	1,41 ± 0,42	1,72 ± 0,55		
Chest	1,79 ± 0,37	1,64 ± 0,38	1,69 ± 0,28	1,82 ± 0,67	1,58 ± 0,51	2,12 ± 0,65	1,67 ± 0,32	1,66 ± 0,69	1,68 ± 0,38	1,79 ± 0,63		
Pelvis	2,49 ± 0,49	2,31 ± 0,60	2,19 ± 0,34	2,18 ± 0,80	2,05 ± 0,56	2,75 ± 0,83	2,25 ± 0,37	2,48 ± 1,22	2,26 ± 0,47	2,43 ± 0,91		
Total Fixation Duration (TFD)												
	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.		
Body	2,27 ± 0,66	1,16 ± 0,46	2,67 ± 0,58	1,11 ± 0,36	2,54 ± 0,79	1,00 ± 0,47	2,51 ± 0,61	1,02 ± 0,55	2,48 ± 0,67	1,07 ± 0,47		
Face	0,64 ± 0,41	0,33 ± 0,23	0,68 ± 0,34	0,33 ± 0,19	0,80 ± 0,42	0,41 ± 0,20	0,70 ± 0,43	0,34 ± 0,23	0,70 ± 0,40	0,35 ± 0,21		
Chest	0,48 ± 0,18	0,22 ± 0,15	0,46 ± 0,20	0,25 ± 0,10	0,52 ± 0,20	0,14 ± 0,10	0,49 ± 0,16	0,25 ± 0,17	0,49 ± 0,18	0,22 ± 0,14		
Pelvis	0,30 ± 0,17	0,20 ± 0,11	0,57 ± 0,22	0,14 ± 0,06	0,39 ± 0,28	0,11 ± 0,09	0,48 ± 0,23	0,10 ± 0,10	0,43 ± 0,24	0,13 ± 0,10		
Fixation Count (FC)												
	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.		
Body	6,33 ± 1,60	3,50 ± 1,24	6,57 ± 1,30	3,30 ± 1,06	6,35 ± 2,00	2,67 ± 1,08	6,65 ± 1,41	2,97 ± 1,51	6,48 ± 1,57	3,11 ± 1,28		
Face	1,24 ± 0,60	0,69 ± 0,41	1,15 ± 0,51	0,78 ± 0,45	1,25 ± 0,52	0,75 ± 0,28	1,26 ± 0,69	0,72 ± 0,44	1,23 ± 0,59	0,73 ± 0,39		
Chest	1,64 ± 0,58	0,76 ± 0,37	1,26 ± 0,41	0,84 ± 0,30	1,72 ± 0,68	0,48 ± 0,26	1,47 ± 0,38	0,87 ± 0,53	1,53 ± 0,54	0,74 ± 0,41		
Pelvis	0,87 ± 0,32	0,62 ± 0,33	1,47 ± 0,50	0,46 ± 0,19	0,97 ± 0,53	0,36 ± 0,27	1,27 ± 0,51	0,32 ± 0,32	1,13 ± 0,52	0,44 ± 0,31		
Subjective Measurements												
	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.	Pref.	Non-pref.		
Valence	7,03 ± 1,00	4,59 ± 1,54	6,99 ± 1,11	4,54 ± 2,06	7,40 ± 1,25	5,19 ± 1,63	7,23 ± 1,27	4,02 ± 1,44	7,17 ± 1,15	4,55 ± 1,68		
Arousal	4,41 ± 2,27	1,45 ± 1,05	5,38 ± 1,73	2,32 ± 1,53	6,07 ± 2,22	2,50 ± 1,45	5,40 ± 2,07	1,51 ± 1,70	5,28 ± 2,14	1,89 ± 1,50		
2D:4D Digit Ratio												
2D:4D	0,9633 ± 0,0359		0,9629 ± 0,0299		0,9385 ± 0,0233		0,9439 ± 0,0290		0,9518 ± 0,0315			

Notes. And. = Androphilic participants; Gyn. = Gynephilic participants; Pref. = targets of the preferred gender; Non-pref. = targets of the non-preferred gender. For eye-tracking variables, results are reported for each area of interest.

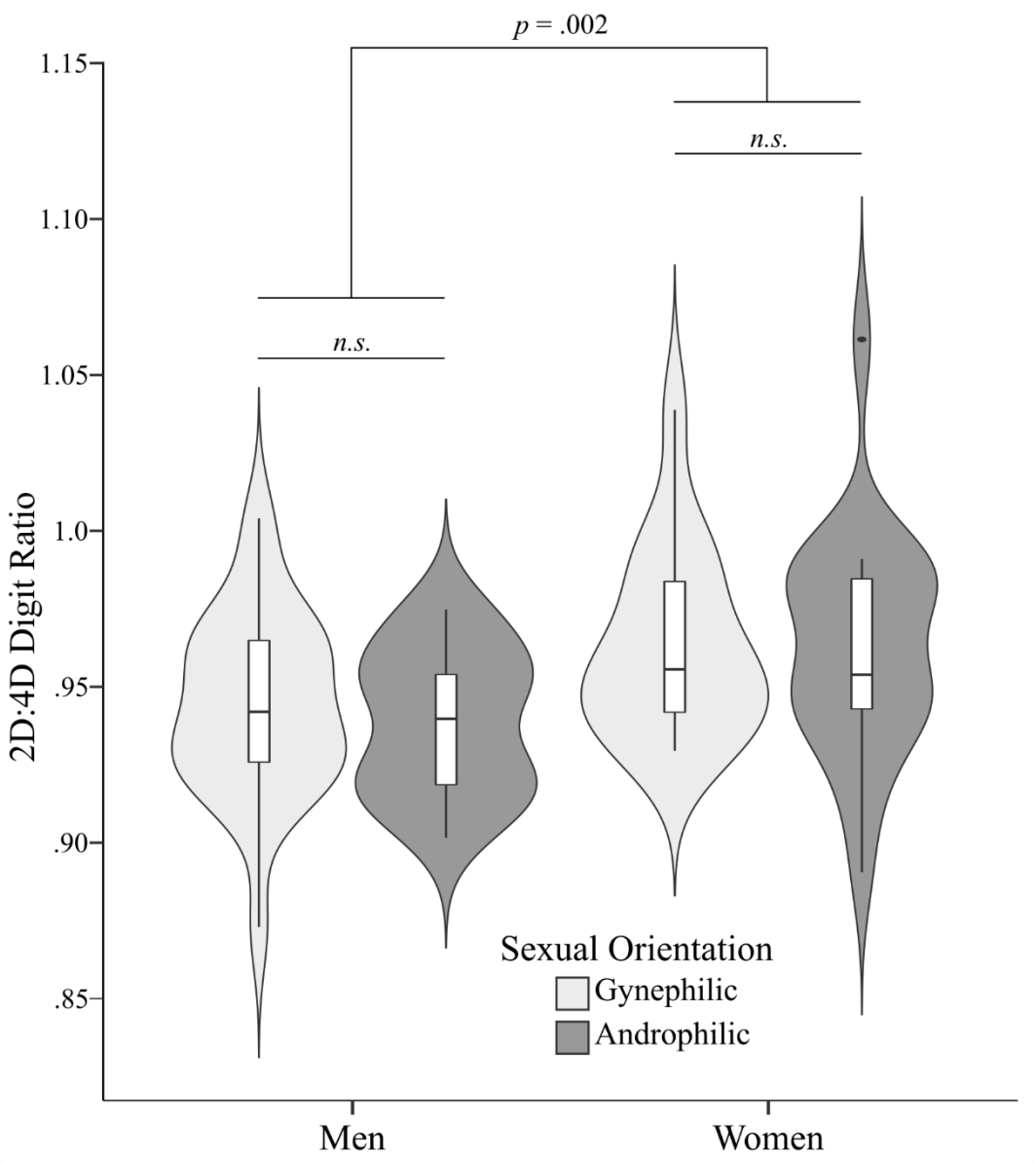

Figure 1. Kernel probability density (violin) plots with boxplots for 2D.4D digit ratio, split by gender and sexual orientation (light grey: Gynephilic; dark grey: androphilic) of the participants. For pairwise *post-hoc* tests, *n.s.* represents a non-significant difference in the 2D.4D ratio between androphilic and gynephilic participants of each gender.

Table 2. *Response variation in fixation patterns, valence, and arousal.*

Effect	Time to First Fixation																Total Fixation Duration											
	Body				Face				Chest				Pelvis				Body				Face				Chest				Pelvis			
Within-subject	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2
TS	**29,14**	**1, 74**	**<.001**	**,283**	**15,10**	**1, 72**	**<.001**	**,173**	2,76	1, 74	,101	,036	2,09	1, 73	,153	,028	**153,15**	**1, 74**	**<.001**	**,674**	**67,38**	**1, 74**	**,000**	**,477**	**99,31**	**1, 74**	**<.001**	**,573**	**106,48**	**1, 74**	**<.001**	**,590**
TS*2D:4D	0,09	1, 73	,770	,001	0,73	1, 71	,396	,010	0,02	1, 73	,877	,000	0,09	1, 72	,760	,001	0,03	1, 73	,858	,000	0,11	1, 73	,745	,001	0,06	1, 73	,806	,001	0,26	1, 73	,612	,004
TS*PS	**4,94**	**1, 74**	**,029**	**,063**	**5,50**	**1, 72**	**,022**	**,071**	3,21	1, 74	,077	,042	4,84	1, 73	,031	,062	0,64	1, 74	,428	,009	0,26	1, 74	,610	,004	1,69	1, 74	,198	,022	1,23	1, 74	,270	,016
TS*PSO	**7,32**	**1, 74**	**,008**	**,090**	2,22	1, 72	,140	,030	**7,41**	**1, 74**	**,008**	**,091**	1,75	1, 73	,190	,023	1,18	1, 74	,280	,016	0,16	1, 74	,692	,002	0,94	1, 74	,336	,013	3,93	1, 74	,051	,050
TS*PS*PSO	0,53	1, 74	,467	,007	0,62	1, 72	,435	,009	0,72	1, 74	,400	,010	0,40	1, 73	,529	,005	0,77	1, 74	,383	,010	0,00	1, 74	,977	,000	2,68	1, 74	,106	,035	**12,59**	**1, 74**	**,001**	**,145**
Between-subject	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2
2D:4D	0,81	1, 73	,370	,011	0,56	1, 71	,456	,008	0,23	1, 73	,636	,003	1,30	1, 72	,257	,018	0,39	1, 73	,533	,005	0,00	1, 73	,973	,000	1,85	1, 73	,178	,025	1,65	1, 73	,203	,022
PS	0,00	1, 74	,980	,000	3,00	1, 72	,088	,040	0,07	1, 74	,787	,001	0,71	1, 73	,403	,010	2,96	1, 74	,588	,004	1,12	1, 74	,293	,015	0,01	1, 74	,923	,000	1,37	1, 74	,246	,018
PSO	0,19	1, 74	,663	,003	0,47	1, 72	,497	,006	1,72	1, 74	,194	,023	0,75	1, 73	,389	,010	2,05	1, 74	,157	,027	0,81	1, 74	,372	,011	0,33	1, 74	,568	,004	1,48	1, 74	,227	,020
PS*PSO	0,16	1, 74	,686	,002	2,10	1, 72	,151	,028	0,65	1, 74	,422	,009	1,27	1, 73	,264	,017	1,63	1, 74	,205	,022	0,26	1, 74	,610	,004	0,55	1, 74	,461	,007	**6,90**	**1, 74**	**,010**	**,085**

Effect	Fixation Count																Subjective Measurements							
	Body				Face				Chest				Pelvis				Valence				Arousal			
Within-subject	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2
TS	**154,25**	**1, 74**	**<.001**	**,676**	**68,86**	**1, 74**	**<.001**	**,482**	**116,41**	**1, 74**	**<.001**	**,611**	**119,13**	**1, 74**	**<.001**	**,617**	**119,60**	**1, 74**	**,000**	**,618**	**150,59**	**1, 74**	**,000**	**,671**
TS*2D:4D	0,00	1, 73	,988	,000	0,78	1, 73	,381	,011	0,00	1, 73	,951	,000	0,48	1, 73	,492	,006	0,41	1, 73	,522	,006	0,09	1, 73	,767	,001
TS*PS	1,36	1, 74	,247	,018	0,25	1, 74	,615	,003	3,35	1, 74	,071	,043	1,58	1, 74	,213	,021	0,30	1, 74	,587	,004	1,70	1, 74	,197	,022
TS*PSO	0,17	1, 74	,685	,002	0,83	1, 74	,366	,011	0,33	1, 74	,567	,004	2,60	1, 74	,111	,034	1,10	1, 74	,298	,015	0,04	1, 74	,848	,000
TS*PS*PSO	0,16	1, 74	,688	,002	0,29	1, 74	,592	,004	**14,25**	**1, 74**	**<.001**	**,162**	**18,22**	**1, 74**	**<.001**	**,198**	1,15	1, 74	,287	,015	0,15	1, 74	,704	,002
Between-subject	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2	*F*	*d.f.*	*p*	η_p^2
2D:4D	0,00	1, 73	,987	,000	0,26	1, 73	,615	,003	0,47	1, 73	,496	,006	3,39	1, 73	,070	,044	0,13	1, 73	,717	,002	0,18	1, 73	,676	,002
PS	2,01	1, 74	,160	,026	0,08	1, 74	,780	,001	0,02	1, 74	,887	,000	**4,18**	**1, 74**	**,044**	**,053**	0,57	1, 74	,455	,008	2,41	1, 74	,125	,032
PSO	0,58	1, 74	,450	,008	0,00	1, 74	,976	,000	2,01	1, 74	,160	,027	0,51	1, 74	,478	,007	1,91	1, 74	,171	,025	**7,98**	**1, 74**	**,006**	**,097**
PS*PSO	0,74	1, 74	,392	,010	0,00	1, 74	,950	,000	0,28	1, 74	,597	,004	**8,01**	**1, 74**	**,006**	**,098**	2,54	1, 74	,115	,033	0,02	1, 74	,884	,000

Notes. TG = Target gender (preferred, non-preferred); PG = Participant gender (men, women); PSO = Participant sexual orientation (gynephilic, androphilic). For eye-tracking measurements, results are split by area of interest. Results are from mixed general linear models for each dependent variable. Interactions with the covariate (2D:4D) are taken from the ANCOVA. All other effects are taken from an ANOVA (Schneider, Avivi-Reich, & Mozuraitis, 2015) performed on the same data without the covariate.

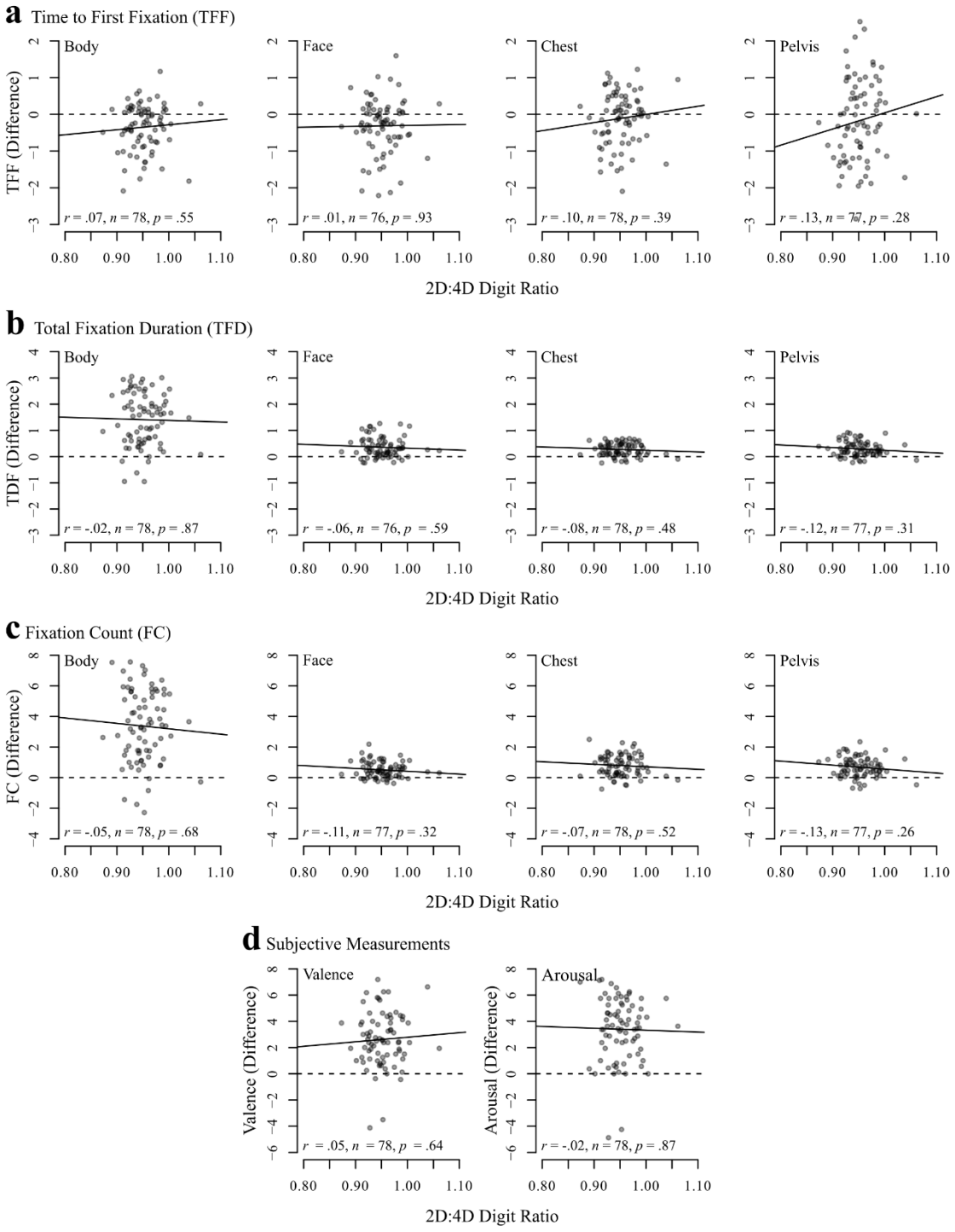

Figure 2. Correlations between 2D.4D digit ratio and all dependent variables. (a) Time to first fixation (TFF); (b) Total fixation duration (TFD); (c) Fixation count (FC); (d) Subjective measurements (valence, arousal). For eye-tracking dependent variables (a, b, c), results are split by AOI (body, face, chest, pelvis). In all cases, the Y axis represents the difference between responses towards preferred stimuli minus non-preferred stimuli. For reference, dotted lines represent no difference between responses towards preferred and non-preferred target stimuli (i.e. a difference of 0), and straight lines represent the linear regression for the association between 2D:4D and the dependent variable. For separate correlations for androphilic and gynephilic men and women, see Table S1, in the Supplementary Materials available online

4.5 Discussion

As expected, we found differences between men's and women's 2D:4D digit ratio, regardless of their sexual orientation (Manning et al., 2007; Manning et al., 2000), but not for men or women with same-gender preferences compared to other-gender sexual preferences; thus, our results do not reliably suggest higher exposure or sensitivity to prenatal testosterone in androphilic men and gynephilic women compared to gynephilic men and androphilic women (Csatho et al., 2003; Kangassalo et al., 2011), unlike Xu & Zheng (2016).

There are several potential explanations for this result. First, there are variations in 2D:4D ratios among nationalities and ethnic groups (Lippa, 2003; Manning et al., 2007). Manning et al. (2007) found high ratios for Polish, Spanish, and English populations, moderate ratios for German, Hungarian, and south Indian populations, and low ratios for Zulu, Finnish, and Jamaican populations. The differences between participants with same and other-gender sexual preferences were present only in white men, but not in black or Chinese men or women; this suggests that variations in 2D:4D among men and women with different sexual orientations are not the same in all ethnicities and nationalities. Our sample was from a typical, highly mixed, South American (Colombian) population for which there are no previous reports relating 2D.4D ratios and sexual orientation.

Currently, sexual orientation is frequently thought to depend on prenatal hormonal exposure that can affect the brain in different ways, resulting in variations in sex-typical characteristics (Rahman, 2005). These influences, however, have not been reliably associated with the 2D:4D digit ratio (Hall & Schaeff , 2008; Putz, Gaulin, Sporter, &

McBurney, 2004), suggesting that atypical prenatal hormonal levels could have a varying degree of influence on 2D:4D ratios, hindering their usefulness as a reliable predictor of sexual orientation. In fact, the existence of mixed results (e.g. Grimbos et al., 2010; Kangassalo et al., 2011; Xu & Zheng, 2016) suggests a weak effect, if there is a real effect, in which case the association between 2D:4D digit ratios and sexual orientation could perhaps only be detected in large samples, and also be affected by ethnic and cultural influences (e.g. local pressures; Kangassalo et al., 2011).

As expected, sexual preferences were evident in visual attention patterns. Both gynephilic and androphilic men and women showed a strong tendency to fixate faster, longer, and more times on stimuli of their preferred gender, as shown in previous research (Chivers, Seto, Lalumiére, Laan, & Grimbos, 2010; Dawson & Chivers, 2016; Rullo, Strassberg, & Israel, 2010). A similar, specific preference towards stimuli of the preferred gender was found for subjective measurements of valence and arousal. Our results show that sexual orientation has an important effect on visual attention patterns in early and late processing of sexually-preferred stimuli (Janssen, Everaerd, Spiering, & Janssen, 2000; Samson & Janssen, 2014; Spiering, Everaerd, & Janssen, 2003). At the same time, visual attention patterns correspond with the subjective perception of sexual attractiveness and arousal to preferred stimuli, indicating that sexually attractive and arousing stimuli attract the gaze of participants (Hewig et al., 2008).

However, we did not find any convincing evidence to support an association between 2D:4D digit ratio and visual attention or the subjective perception of sexual attractive and arousal towards sexually preferred stimuli or areas of interest, unlike Huh (2013) or Xu and Zheng (2016), but similar to Strong (2014). Although all groups -- gynephilic and androphilic men and women -- fixated faster, longer, and more often on both erotic (chest, pelvis) and non-erotic (face) areas of their sexually preferred stimuli,

and rated targets of their preferred gender as more attractive and sexually arousing, this effect did not increase in participants with lower (more masculinised) 2D:4D ratios, even though the relationships were generally in the expected direction. Thus, we did not find evidence for the hypothesis of Chivers (2017) about a possible early neurohormonal influence on response specificity in adulthood.

There are two plausible and related explanations: 2D:4D ratio is not an accurate marker of prenatal androgen exposure (Bailey et al., 2016; Hampson & Sankar, 2012), or prenatal androgen exposure has a weak effect on sexual orientation and sexual behaviour, although that conflicts with recent evidence (i.e. Hamann et al., 2014; Zheng & Cohn, 2011). Berenbaum, Bryk, Nowak, Quigley, & Moffat, (2009), who analysed XY men without normal exposure to prenatal testosterone due to androgen insensitivity syndrome, found that digit ratios were significantly higher in these men compared to typical men and similar to those of typical women, with moderate effect sizes but great within-group variability. At the same time, Bailey et al., (2016) say that dimorphism in 2D:4D ratios is not large and, therefore, may not be an accurate marker of testosterone prenatal exposure, which would explain the variable results and their lack correlations with sexual orientation and associated behavioural patterns, such as attention bias towards sexually preferred stimuli. This is possible because finger ratio can be affected by other factors not limited to androgen action (e.g. ethnicity, handedness; see Cohen-Bendahana, van de Beek, & Berenbaum, 2005; Hampson & Sankar, 2012; Zheng & Cohn, 2011).

Even if there is a relationship between prenatal androgen exposure and 2D:4D ratios, there may be no association between digit ratios and some sexual dimorphic characteristics and behaviours, even though there is evidence suggesting both are influenced by prenatal sex hormones (e.g., Hamann et al., 2014). A possible explanation could be a difference of developmental timing between 2D:4D ratios and sex-typical

characteristics (Cohen-Bendahana et al., 2005; Puts et al., 2004); if true, this could lead to a weak correlation between them, making 2D:4D a limited predictor of traits mediated by sex hormones such as sexual orientation and some sex-typical behaviours, which could be also influenced by additional factors, including postnatal hormone circulation, and socialisation (Chivers, 2017; Hamann et al., 2014).

Our results add to the growing controversy about whether the 2D:4D ratio is a good enough indicator to test whether androgen exposure influences sexual orientation and sexual behaviour patterns. Evidence shows the marker is not necessarily unreliable, but its weak effect suggests that is not very accurate or useful to measure the effect of prenatal hormones on sexual orientation and associated behavioural patterns, given its multi-causality and the effect of other factors on patterns of sex-typical behaviour. The relationship between the 2D:4D ratio and gender differences or sexual orientation could be affected by several causes other than prenatal androgen levels, potentially contributing to correlations with different tendencies and effect sizes. To the best of our knowledge, only our study and Huh (2013) have looked at associations between attentional bias towards body areas of sexually preferred stimuli and 2D:4D ratios, although with important methodological differences; we think our study increases ecological validity because we used eye-tracking techniques and a free exploration paradigm, in contrast to the forced attention paradigm used by Huh (2013). Furthermore, our design included both gender and sexual orientation, and the effects of these factors on visual patterns.

A potential limitation of the present study is that we only analysed right-hand 2D:4D ratios. We did this because there is evidence that the right hand (both in human and another mammalian species) is more sensitive to hormonal effects (e.g. Brown, Finn, & Breedlove, 2002; Hönekopp & Watson, 2010; Huh, 2013; Zheng & Cohn, 2011). However, future studies could include analyses of left-hand ratios to test possible

variations in effect sizes (Xu & Zheng, 2016). Furthermore, in our study, sexual orientation was measured as a categorical variable, but recent research has emphasized the importance of measuring gender orientation on a continuum (Chivers, Bouchard, & Timmers, 2015). Finally, future studies could include cross-ethnic samples, consider gender roles and identity, and directly measure circulating hormonal levels.

In conclusion, using a novel, ecologically valid design, we found no evidence of any relationship between prenatal hormonal exposure (measured using 2D:4D ratios) and the strength of preferences towards targets of the preferred gender, according to the gender sexual orientation of our participants.

4.6 Supplementary Materials

4.6.1 Supplementary Methods

Eye Movement Data Collection

The experimental phase consisted of three stages. In the first, eye movements were recorded using Tobii Studio™ Eye Tracker, Tobii Pro X2-60 (Tobii Technology AB, Stockholm, Sweden) at a sampling rate of 60 Hz, spatial resolution of < 02°, and accuracy of a visual angle of less than 0.5°. The participant was placed 65 cm away from the screen, and the calibration process was performed, which consisted of looking at a black dot inside a red circle moving through different points on the screen.

Once the calibration was completed, 32 black and white images of adults (5000ms) downloaded from free Internet sites were presented for 5s each, with a 500ms fixation point between, partially following the design of Fromberger et al. (2012). The pictures were selected to appear as Tanner stage V (Tanner, 1962); six observers estimated the ages of all the images (women, mean age of 26.47, ± SD= 3.72; and men, mean age of 28.43, ± SD = 1.67).

In the experiment, two images of semi-naked adults (man and woman) were simultaneously presented. In each trial, one image was presented on one side of the screen in the upper or lower corner, and the second image was presented on the opposite side and corner, with 680 pixels from the centre of one image to the centre of the other. The images were pseudo-randomized to the four possible corners of the screen to avoid gaze bias.

The experiment started with a brief instruction that said "freely observe the following images", informing participants that some practice stimuli would appear so that they would be able to adjust to the equipment and the task. The practice session included

8 trials composed of competing images of fully-clothed adult men and women. Once the participant had finished the practice trials, the instruction was repeated, and the presentation of the experimental stimuli commenced.

Subjective Sexual Attractive measurements

After the presentation of the experimental stimuli, an image depicting each individual stimulus was presented again at the centre of the screen, in order to obtain valence and arousal ratings from the participants on a 9-point pictographic scale (valence 1= unpleasant to 9= pleasant; sexual arousal 1 = not arousing to 9= arousing; Bradley & Lang, 1994).

2D:4D Ratio

In a third stage, the 2D:4D ratio was measured using the scanning method (Ryckmans, Millet, & Warlop, 2015) with the right hand, which is highly correlated with direct measurement (r = .88). Participants were instructed to place the palm of their right hand on the glass of a Cannon Lide 120 scanner. Hands were scanned with a 400 dpi resolution, making sure that the hand was extended and applying light pressure on the glass and that the folds of the second and fourth digits were clearly displayed. In subsequent analyses, finger length was measured by three blind evaluators using Autometric software (DeBruine, 2004), measuring from the nearest palmar digital crease to the tip of the index and annular fingers. The evaluators were trained to perform the measurements through the software and instructed to encode two measurements; if the measurements differed by more than 0.5 mm, a third measurement was performed that would also be repeated and recorded. If the two measurements made by the judges differed by less than 0.5 mm, they were averaged.

The Intraclass Correlation Coefficient (ICC) of mean measurements was used to find the equivalence of measurements between observers, as described in Ryckmans et

al. (2015), obtaining a very good level of concurrence (ICC = .918, p <.001). The average of the measurements performed by the evaluators was used for our statistical analyses.

4.6.2 Statistical analyses

We used mixed general linear models for each variable, using target gender (TG) as the within-subject factor, participant gender and participant sexual orientation (PSO) as between-subjects factors, and 2D:4D ratio as a covariate. Target gender was categorised as *preferred* (male targets for androphilic men and women; female targets for gynephilic men and women) or *non-preferred* (female targets for androphilic women and men; male targets for gynephilic men and women). Because the 2D:4D ratio is a time-invariant variable, we centred the covariate values to its mean (Delaney & Maxwell, 1981; Schneider, Avivi-Reich, & Mozuraitis, 2015; Taylor, 2011). For each dependent variable, we first created a model without including the covariate, and then another model including 2D:4D ratio as a covariate (Schneider et al., 2015). A significant interaction between a covariate and a within-subject factor would suggest that there is a difference in the slope of the regression relating the covariate to the dependent variable for each level of the within-subject factor; for example, a significant interaction between TG (preferred, non-preferred) and 2D:4D would indicate there are significantly different regression slopes of the 2D:4D ratio and the studied dependent variable for targets of the preferred and non-preferred gender.

For significant interactions between 2D:4D and target gender, we planned to perform further analyses, including the covariate centred to the mean and low and high values (mean ± 2SD). Comparing the main effect of target gender across different levels of the covariate would be of particular interest (Taylor, 2011) because it shows predicted effects on the dependent variable for participants with different levels of the covariate

(low, mean, and high 2D:4D). However, we found no significant interactions between 2D:4D and target gender for any of the dependent variables.

Additionally, to represent the effect of the 2D:4D ratio on each of the 14 dependent variables (listed), we performed correlation analyses; in all cases, the correlations were between 2D:4D and a difference score, calculated as responses towards stimuli of the preferred gender, minus responses towards stimuli of the non-preferred gender.

4.6.3 Supplementary Results

Table S1.
Correlations between 2D.4D digit ratio and attentional bias towards preferred-gender targets.

		Time to first fixation				**Total duration fixation**				**Count fixation**				**Subjective measurements**	
		Body	Face	Chest	Pelvis	Body	Face	Chest	Pelvis	Body	Face	Chest	Pelvis	Valence	Arousal
Men	And.	.041	-.195	-.018	.154	.090	-.166	.370	.044	.137	-.186	.467	-.004	-.178	-.057
	Gyn.	.116	.119	-.059	.035	.048	.132	.095	-.221	-.035	-.082	.044	-.211	.049	-.251
Women	And.	.161	.104	**.521***	.243	.050	.095	-.186	-.053	-.050	-.005	-.187	-.173	.144	.295
	Gyn.	-.443	**-.585***	-.327	-.341	-.150	-.405	-.306	.058	.012	-.222	-.163	.149	.264	.335

Note. And. = Androphilic participants; Gyn. = Gynephilic participants; Significant correlations are in bold: *p < .05. Attentional bias towards targets of the preferred gender, was calculated as the difference between responses towards preferred stimuli minus non-preferred stimuli.

4.6.4 Supplementary References

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CAPÍTULO 5.ESTUDIO 3. DIFFERENCES IN VISUAL ATTENTION PATTERNS TO SEXUALLY MATURE AND IMMATURE STIMULI BETWEEN HETEROSEXUAL SEXUAL OFFENDERS, NONSEXUAL OFFENDERS AND NONOFFENDING MEN

Los principales resultados del presente capítulo están bajo revisión:

Vásquez-Amézquita, M., Leongómez, J. D., Seto, M. C., & Salvador, A. (2018). Differences in Visual Attention Patterns to Sexually Mature and Immature Stimuli between Heterosexual Sexual Offenders, Nonsexual Offenders and Nonoffending Men. *Journal of Sex Research*.

5.1 Abstract

Men and women, whether gynephilic or androphilic, show both early and late attention biases towards adults and not towards children. We examined early and late visual attention patterns to sexually mature versus immature stimuli in four groups of heterosexual men: Sexual offenders against children (SOAC), sexual offenders against adults (SOAA), nonsexual offenders (NSO), and nonoffending men (NOM). We simultaneously presented adult and child stimuli and measured time to first fixation, number of first fixations, total duration of fixation, and fixation count to four areas of interest: entire body, then face, chest, and pelvis. We found a significant interaction where only SOAC tended to fixate more first times to child than to adult stimuli. Conversely, we found longer total duration of fixations for the bodies of adults compared to the bodies of children in all groups; however, in both the total duration of fixations and the fixation count for the whole body, but especially in the chest, SOAC tended to fixate longer and more often on child stimuli than the other two groups of offenders, but not longer or more often than NOM. This study adds to the limited research using eye-tracking techniques in samples of sexual offenders against children.

5.2 Introduction

Recent studies have demonstrated that emotional stimuli that are relevant for reproduction will capture attention for a longer time than non-reproduction related stimuli (Calvo & Lang, 2004; Carretié, 2014; Nummenmaa et al., 2006). For this reason, sexual response theories attribute a role to attentional processes as indicators of sexual response and sexual preferences (Geer & Melton, 1997; Janssen, Everaerd, Spiering, & Janssen, 2000). Sexual stimuli tend to attract attention more easily than non-sexual stimuli because the former have strong incentive value (Both, Everaerd, & Laan, 2007). If a stimulus has sexual significance, it can trigger an initial pre-conscious process followed by a process of conscious attention that could influence the decision to approach or avoid the stimulus (Fromberger et al., 2013; Geer & Bellard, 1996; Krupp, 2008).

According to the information processing model of sexual arousal, sexual response is the result of the interaction between early (pre-conscious) and late (conscious) cognitive processes (Spiering, Everaerd, & Elzinga, 2002). When a stimulus with relevant sexual cues coincides with information stored in implicit memory, there is a pre-attentional bias towards it, leading to the onset of a physiological sexual response (Janssen & Everaerd, 1993; Spiering & Everaerd, 2007). For a subjective sexual response to take place, the conscious processing of sexual information is also required. Therefore, if the pre-attended sexual cues coincide with the information contained in explicit memory, a full sexual response will be produced, comprising physiological, subjective, and behavioral components (Spiering, Everaerd, & Janssen, 2003). The conscious processing of sexual information influences the amount of attention to the stimulus.

5.2.1 Sexual Gender Interests

Paradigms based on measuring visual attention using eye-tracking techniques are a useful and non-invasive method to identify sexual interests (S. J. Dawson & Chivers, 2016; Wenzlaff, Briken, & Dekker, 2016). Studies have consistently found that both gynephilic (female-attracted) and androphilic (male-attracted) men from the general community show a specific visual attention pattern corresponding to their sexual orientation for gender (Fromberger, Jordan, von Herder, et al., 2012; Mitrovic, Tinio, & Leder, 2016; Vásquez-Amézquita et al., 2017), in which they tend to fixate faster and longer on the bodies and specific areas like the face, chest and pelvis of their preferred gender (Dixson, Grimshaw, Linklater, & Dixson, 2011; Nummenmaa, Hietanen, Santtila, & Hyönä, 2012; Vásquez-Amézquita et al., 2017, 2018).

5.2.2 Age Interests

There is a plethora of studies that have used attentional paradigms as an indirect measure of sexual interest for sexual offenders, using number of correct responses, reaction time, or viewing time as indicators (Babchishin, Nunes, & Kessous, 2014; Crooks, Rostill-Brookes, Beech, & Bickley, 2009; Dombert et al., 2017; Flak, 2011; Mokros et al., 2013; Ó Ciardha & Gormley, 2012; Renaud et al., 2009). These studies report shorter response latencies and longer viewing times in sexual offenders against children when the target is a child stimulus. Only a few studies have used eye-tracking (Fromberger et al., 2013; Fromberger, Jordan, Steinkrauss, et al., 2012; Hall, Hogue, & Guo, 2015; Jordan et al., 2016). Results from the two studies with pedophilic participants (Fromberger et al., 2013; Fromberger, Jordan, Steinkrauss, et al., 2012) suggest that men who are sexually interested in children indeed have attentional biases towards prepubescent children. Fromberger, Jordan, Steinkrauss, et al. (Fromberger, Jordan,

Steinkrauss, et al., 2012) found that pedophilic men showed shorter latencies (early attention) and longer duration of fixation (late attention) to child stimuli when they competed with adult stimuli. Fromberger et al. (Fromberger et al., 2013) later found shorter latencies towards child stimuli in pedophilic men, as expected, but longer fixation times on adult stimuli in both pedophilic and non-pedophilic men.

These authors explain it is possible that pre-conscious fixation latency and first fixations are better indicators of pedophilic sexual interests than late attention, which is more susceptible to conscious control (Fromberger et al., 2013; Fromberger, Jordan, Steinkrauss, et al., 2012). In both studies, though, the researchers used forced attention paradigms, which demand an instrumental response that might bias natural ocular movements and hint at the full purpose of the research to participants (Hall, Hogue, & Guo, 2011). This could affect intentional manipulation of gaze toward sexual stimuli, especially when there is interest in giving socially desirable responses. An alternative is to use free-viewing paradigms to avoid constraining spontaneous visual patterns and only present the full purpose of the study at the end of their participation (Attard-Johnson et al., 2016b; Hall et al., 2011; Lykins, Meana, & Strauss, 2008).

A recent study (Vásquez-Amézquita et al., 2017) reported that community participants focus on specific body areas, both erotic (chest and pelvis) and non-erotic (face), for a longer time with sexually preferred adult stimuli than to non-preferred child stimuli, and that the area that received the least attention in child stimuli was the pelvic region. It is unclear whether specific body areas of children are selectively attended to by pedophilic sex offenders against children. Fromberger et al. (Fromberger et al., 2013) found pedophilic participants were first and longest attracted by children's faces and pubic regions. However, Hall et al. (Hall et al., 2015) compared gaze patterns of convicted offenders against girls to heterosexual non-offending men in a free-viewing task

involving images of clothed male and female stimuli aged 10, 20 and 40 years old. They found that the offenders against girls tended (but not significantly) to look more often at the upper body of the female child than male child stimuli, whereas non-offenders showed no difference in the fixation counts to the upper body when viewing male or female child stimuli. However, they found that the difference in fixation frequency towards the upper body of for female minus male stimuli, was significantly greater for offenders against girls than non-offenders.

5.2.3 The Present Study

Given the potential value of studying visual attention patterns as a reliable and valid measurement of sexual responses and preferences, we conducted the current study to see if this method could be useful in differentiating sexual offenders against children from other sexual and non-sexual offenders and non-offenders, and if it would be potentially useful in the assessment of pedophilic interests.

In this study, we compared early and late attention viewing patterns to sexually mature (adult) stimuli in competition with sexually immature (child) stimuli, following the Fromberger et al. (2013) paradigm. We did so with four groups of heterosexual men: (1) convicted sex offenders against children, (2) convicted sex offenders against adults, (3) convicted nonsexual offenders, and (4) nonoffending men. We expected that sexual offenders against children would show a higher number of first fixations and lower shorter latencies (early attention), as well as a longer duration of fixations (late attention), towards child stimuli relative to adult stimuli, compared to sexual offenders against adults, nonsexual offenders, and nonoffenders. We also examined early and late attention to erotic and non-erotic body areas.

5.3 Method

5.3.1 Participants

A total of 71 heterosexual men took part in the study, from an initial sample of 113 recruited participants. They were divided into three offender groups and one control group: (1) sexual offenders against children (n=18), (2) sexual offenders against adults (n=16), (3) nonsexual offenders (n=18), and (4) nonoffending men (n=19). The characteristics of each group are reported on Table 1.

Table 1.

Characteristics of the subject groups.

Measurement	**Group**								**GLM**		
	SOAC		**SOAA**		**NSO**		**NOM**				
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	η^2_p
Age	44.5	14.13	40.25	16.68	39.22	10.69	40.42	11.42	0.55	0.65	0.02
Children and sex cognitive distortions scale	39.06	3.52	12.25	2.41	12.33	4.14	11.79	3.01	289.34	0	0.92
Education	%		%		%		%		-		
None	0		12.5		0		5.26		-		
Primary	38.9		50		38.9		21.05		-		
Secondary	61.1		37.5		61.1		73.68		-		
Admits commission of sexual offense[1]	33		25		-		-		-		

SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men.

[1] Percentage of sexual offenders that admitted commission of the sexual offense. There were no significant differences in any of the variables measured between those who accepted and denied the offense ($p > .16$ in all cases).

Recruitment of offenders was carried out in a prison in Bogota, Colombia. We began by recruiting men convicted and sentenced for *abusive carnal access with a minor under fourteen years of age* (as defined in Colombian law; see *Código Penal*, 2004), which involves vaginal, anal, or oral penetration with a penis or object. Participants were selected from men who had a victim under the age of 12; 74 men were invited to take part in the study, of which 38 voluntarily accepted. From the 38 that agreed to participate, 5 reported severe or uncorrected visual defects, and of the remaining 33, 29 completed all questionnaires (4 participants did not finish one or more questionnaires and did not continue with the research, e.g., because they were relocated).

We were not able to perform a forensic psychiatric evaluation to make an accurate assessment of pedophilia, because at that time, neither we nor the jail had a qualified professional. Moreover, prison files did not contain sufficient information to assess pedophilic sexual interests on the basis of sexual victim characteristics using a measure such as the Screening Scale for Pedophilic Interests or its revised version (Seto & Lalumière, 2001; Seto, Stephens, Lalumière, & Cantor, 2017). Thus, we applied the children and sex cognitions scale (Waldron et al., 2006), of which we used seven items: the scores of items 7 (Children can flirt with adults) and 9 (When adults and children have sexual relationships, it's not always the adult's fault) of Factor 1 -- perception of children as sexually mature -- and items 11 (If children want, they should be allowed have sexual relationships with adults), 12 (There is no harm in sexual contact between children and adults), 13 (Most sexual contact between children and adults does not cause any harm), 14 (There is nothing wrong with sexual contact between children and adults), and 15 (Children want sexual contact with adults) of Factor 2 -- justifications for sex with children -- as selection criteria for the group of sexual offenders against children. These

seven items were chosen based on the assessment of four local psychologists that they were relevant to sexual interests towards children.

We selected sexual offenders against children with a score of 3 or 4 (which ranged from 0, very false, to 4, very true) on each of these seven items. For the other three groups, we included only participants who had scores of 0 or 1 on these items. The total score for this set of 7 items strongly correlated with the score of the total cognition scale ($r = .892$, $p < 0.001$). From the 29 participants with acceptable vision and who completed questionnaires, three participants who scored less than 3 on each of seven items were excluded, resulting in 26 participants. These participants completed the experiment, but eight were excluded from the final data analysis for the following reasons: they had eye structure recognition problems at the time of eye-tracker calibration ($n = 4$), or presented other issues such as sleepiness ($n=2$), or loss of attention on the screen ($n=2$), which lead to records with less than 80% of the participant's eye movements The final sample consisted of 18 offenders against children (of which only 6 participants admitted their sexual offense, Table 1).

For the sexual offender against adults group, we recruited 32 participants. Two had symptoms of psychiatric illnesses and three reported severe or uncorrected visual defects. The remaining 27 completed all questionnaires. Four participants were excluded because they had scores greater than 1 on each of the seven items in the children and sex cognitions scale. Twenty-three participants did the experiment, of which seven were excluded from the final sample for the same reasons noted above. The final sample consisted of 16 sex offenders against adult (i.e. 18 or older) women, without any history of sexual offenses against children; their crime was typified as *violent carnal access*, which indicates nonconsensual violent vaginal, anal, or oral penetration with the penis or other object (only 4 participants admitted their sexual offense, Table 1).

For the nonsexual offender group, we recruited 28 participants. Based on the results on each of seven items in the children and sex cognitions scale, two participants were excluded and two more withdrew their cooperation before the experiment. Twenty-four participants did the experiment, but six were excluded from the final sample for the noted reasons. The final sample consisted of 18 men convicted of a nonsexual crime (e.g., homicide; armed robbery, illegal drug possession), with no record of prior sexual offences. All three offender groups were similar in age and education level. Although this was not an original selection criterion, all participants, including sexual offenders against children, reported being heterosexual according to the Kinsey Scale (Kinsey, Pomeroy, & Martin, 2003). We compared sexual offenders who admitted or denied their sexual offense, for both sexual offender groups, and found no significant differences in any of the variables measured between those who accepted and denied the offense (Table 1).

For the nonoffending control group, we recruited 22 participants, who completed all questionnaires. Two were excluded because they scored more than 1 in the items of children and sex cognitions scale. Twenty participants did the experiment, of which one was excluded from the final sample for the noted reasons. The final sample consisted of 19 men who scored 0 or 1 (exclusively or mainly heterosexual) on the Kinsey scale, and had no criminal records. They were recruited from security personnel from private companies in the city. Nonoffending participants had similar ages and education levels to the three offender groups.

All participants completed a questionnaire with items about sociodemographic characteristics, medical and psychiatric history, and the abbreviated Symptom Assessment-45 Questionnaire (SA-45) (Sandín, Valiente, Chorot, Santed, & Lostao, 2008) to check for psychosomatic symptoms. The experimental protocol was approved by the University's Committee on Research Ethics and all participants signed the

informed consent agreeing to voluntarily participate in the study. We were not allowed to offer any incentives for participation in our study by the Ethics Committee, which was concerned that giving incentives for participation could be a form of undue inducement for the incarcerated offenders.

5.3.2 Apparatus and Materials

Eye Tracker.

For recording of eye movements and analysis of fixations, we used the Tobii Studio™ Eye Tracker, Tobii Pro X2-60 integrated with the Tobii Studio Pro Version 3.3.2 (Tobii Technology AB, Stockholm, Sweden), at a sampling rate of 60Hz, a spatial resolution <0.2° of visual angle, and a gaze accuracy of less than 0.5°. Participants watched the stimuli on a 17-inch TFT monitor with a screen resolution of 1440 x 900 and a 60Hz refresh rate. For the identification of fixations, the Tobii Fixation Filter was used, which removes saccades and filters fixations longer than 100ms, with a dispersion threshold of 30 pixels for the same fixation (Dawson, Fretz, & Chivers, 2017).

Stimuli.

The experiment consisted of 64 trials containing images of adults and children; each trial displayed a pair of images depicting people who differed in age (adult vs. child), but not gender. Of the 64 trials, half were female pairs (woman versus prepubertal girl) and half were male pairs (man versus prepubertal boy), following the experimental design established by Fromberger et al. (Fromberger et al., 2013). Stimuli were the same as those used in the second experiment by Vásquez-Amézquita et al. (2017), composed of 64 pictures taken from freely accessible internet sites depicting non-erotic and non-pornographic images of persons. All the depicted individuals were semi-clothed, wearing

either underwear or a bathing suit, in a neutral position, and with a neutral facial expression.

To obtain the age estimates of the stimuli, Vásquez-Amézquita et al, (2017) did a pilot study with a total of 8 adult observers, 4 men (mean age ± SD = 23.2 ± 5.6 years) and 4 women (21.9 ± 5 3.3 years old) who estimated the age of each stimulus. For stimuli depicting boys and girls, 8 had perceived ages under 9 (girls: 8.9 ± 0.8; boys: 8.7 ± 0.7) and 8 had perceived ages between 10 and 12 years (girls: 11.66 ± 0.56; boys: 11.75 ± 0.44). For adult stimuli, the perceived average age of women was 26.4 (± 3.7), and for men was 28.4 (± 1.7).

Based on Fromberger et al. (Fromberger et al., 2013; Fromberger, Jordan, von Herder, et al., 2012), all stimuli were transformed and presented in greyscale on a white background, with similar contrast, illumination, and brightness to control bottom-up effects on the attentional processes, based on low-level characteristics of the stimuli (see too Nummenmaa, Hyönä, & Calvo, 2006). The presentation of the stimuli was pseudo-randomized between the four corners of the screen, so that stimuli of the four categories appeared in the four possible locations, and each stimulus appeared twice during the experiment, in a different location and paired with a different stimulus. No stimulus could be repeated in adjacent trials. A distance of 680 pixels between stimuli was established, calculated from the center of one stimulus to the center of the other. The height of each stimulus was 453 pixels. Each stimulus was presented for 5s on the screen with a fixation cross between stimuli that lasted 500ms.

Subjective ratings.

To evaluate the images, participants returned to see each stimulus individually and were instructed to rate on a 9-point pictographic scale, the level of valence of each

stimulus (ranging from 1 = unpleasant, to 9 = pleasant) and the level of sexual arousal (ranging from 1 = not arousing, to 9 = arousing). Each image was presented in the center of the screen for 4s, with an interval of 4s to rate them.

5.3.3 Procedure

Participants completed the questionnaires and were invited to take part in a study about sexual preferences. The instruction stated that "you will participate in a study about sexual preferences, at the end of the experiment you will be able to ask all the questions that you consider pertinent". They were informed that they would view pictures of men, women, and children. Participants were not informed that their eye movements had been recorded nor the full purpose of the experiment until the end of the session; they were then informed they had the right to accept or reject the use of their recorded data for research purposes. All participants accepted the use of their data for this study after the debriefing.

Participants from the three offender groups carried out the whole procedure within the prison, and nonoffending participants went to a university laboratory. For all groups, the experiment was conducted in an individual session in which participants were asked to sit in front of the computer monitor at an average distance of 65cm from the screen, where the calibration and recording of the eye movements were made while they viewed the stimuli.

For the calibration, participants were not explicitly informed that their eye movements would be recorded. They were told that before the study proper, we would carry out a procedure to be sure that they would be attentive to the task that would be

carried out later. The calibration consisted in tracking a moving dot to nine points on the screen. Once the calibration was accepted, the experiment commenced.

Unlike Fromberger et al (2013; 2012) who asked the participant to respond to a question about attractive of stimuli, we used a free viewing paradigm without specific instruction to avoid constraining participants' eye movements. After calibration, at the beginning of the experiment, the instruction for participants on the screen was simply "freely view the images as you would normally do", to avoid biasing natural gaze patterns (Attard-Johnson et al., 2016b; Hall et al., 2015, 2011). Eight practice trials with different stimuli to those used in the experiment were presented, depicting pairs of fully-clothed people.

5.3.4 Statistical Analyses

The number of first fixations and the time to first fixation on an area of interest were used as indicators of early attention (Fromberger et al., 2013; Fromberger, Jordan, von Herder, et al., 2012). For the measurement of late attentional processes, we used the total duration of fixations, which is the average of the total amount of time spent looking at an area of interest, as well as the fixation count (Dawson & Chivers, 2016). For early attention measures, we analyzed only responses to the whole body, because previous findings (Vasquez-Amézquita et al., 2017) showed that early attention is drawn to the whole body rather than a specific area, as suggested by Fromberger et al. (2012, 2013). For late attention measures we analyzed the whole body and then three specific regions of interest: face (non-erotic), chest and pelvis (erotic). We also analyzed the attractiveness ratings given to each stimulus.

We used 2x2x4 mixed-design general linear models for each dependent variable (number of first fixations, time to first fixation, total duration of fixations, and fixation count), with Bonferroni correction to $\alpha = .0125$ because we performed four analyses. In all models, target age (child, adult) and target gender (male, female) were entered as within-subject factors, and group (sexual offenders against children, sexual offenders against adults, nonsexual offenders, nonoffending men) as a between-subject factor. To further explore effects and interactions, we used simple planned contrasts, comparing responses from Group 1 (sexual offenders against children), to those of the other groups. Post-hoc 2 (target age) x 2 (target gender) analyses were conducted for each group, as well as pairwise comparisons (t tests) comparing responses according to target age for male and female stimuli separately. All tests were two-tailed.

5.4 Results

5.4.1 Early Attention

The main general linear models, as well as the planned contrasts, are reported on Table 2. While there were no significant main effects or interactions for time to first fixation involving either target age or gender, there was a significant main effect of group: Planned contrasts revealed that sexual offenders against children fixated on targets significantly faster than nonsexual offenders, regardless of the age and gender of those targets (Table 2).

For the number of first fixations, there was a significant target age * group interaction (Table 2), in which nonoffending men and sexual offenders against adults tended to fixate a larger number of first times to adult compared to child targets, while no such tendency was present for nonsexual offenders, and an opposite tendency (i.e. a

higher number of first fixations on child versus adult targets, especially girls) was seen in offenders against children (Fig. 1).

Finally, as with time to first fixation, there was a significant main effect of group; planned contrasts showed, however, that differences in the number of first fixations between sexual offenders against children and the other groups did not reach statistical significance (Table 2).

Table 2.
Response variation in early attention measurements.

Effect	**Measurement**					
	Time to First Fixation			**Number of First Fixations**		
Within-subject Effect	*F*	*p*	η^2_p	*F*	*p*	η^2_p
TA	1.03	.313	.015	2.22	.141	.032
TA * Group	1.13	.344	.048	**6.30**	**.001**	**.220**
TG	0.01	.906	.000	0.50	.483	.007
TG * Group	0.63	.596	.028	0.95	.421	.041
TA * TG	4.01	.049	.056	0.37	.545	.005
TA * TG * Group	2.02	.119	.083	1.00	.400	.043
Between-subject Effect	*F*	*p*	η^2_p	*F*	*p*	η^2_p
Group	**5.00**	**.003**	**.183**	**6.91**	**<.001**	**.236**
Planned Contrasts		*p*			*p*	
SOAC vs SOAA		.097			.066	
SOAC vs NSO		**.012**			.031	
SOAC vs NOM		.391			.078	

TA = Target Age, TG= Target gender. SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men. Results are from mixed-design general linear models (d.f. = 1, 67 for main effects and interactions between TA and TG; 3, 67 for Group or interactions with Group) with Bonferroni adjustment for multiple tests (α = .0125). For descriptive statistics, see Table S1 in the Supplementary Materials.

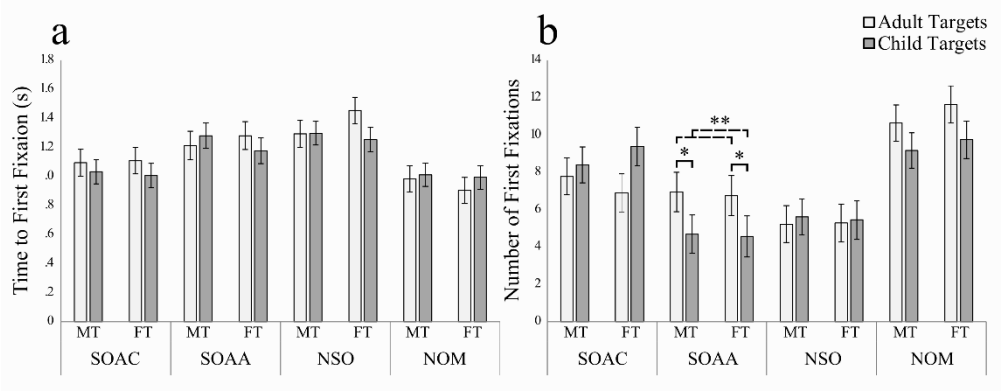

Figure 1. Time to first fixation (a) and number of first fixations (b). Results are split by group (SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men), as well as target age (adult targets: white bars; child targets: grey bars) and target gender (MT: male targets; FT: female targets). Bars represent estimated marginal means ±1 SEM. For interactions, dashed lines represent an effect of target age (adult, child). Post hoc tests: **p* < .0125; ***p* < .001. For detailed results, see Table S2 (post hoc general linear models) and Table S3 (post hoc *t*-tests) in the Supplementary Results.

5.4.2 Late Attention

Because measurements of late attention (total duration of fixation, fixation count) were analyzed for three specific areas of interest (face, chest, pelvis) in addition to the entire body, results are presented separately.

Total duration of fixation.

Main effects and interactions are reported on Table 3, with an emphasis on effects and interactions involving target age, reflecting the experimental design.

There was a large, significant main effect of target age, in which participants from every group, and regardless of the gender of the targets, fixated on adult targets for a longer mean total time than on child targets (Fig. 2a). This effect was particularly strong when comparing differences in total fixation duration to adult versus child targets in erotic areas (chest, pelvis; Fig. 2c, 2d), and smaller (and not significant after Bonferroni correction), for the face (Fig. 2b).

For erotic areas of interest (chest, pelvis), we also found a significant interaction between target age and group (Table 3). In both cases, while all participant groups tended to fixate for a longer total time on the chest and pelvis of adult compared to child targets, nonoffending men showed a stronger preference for adult targets than participants from other groups (Fig. 2c, 2d).

Target age also significantly interacted with target gender; consistent with their stated heterosexual orientations, participants fixated for a longer time on women than on men, boys, or girls (Table 3; Fig. 2a). Looking at specific areas of interest, we found that this same tendency was apparent in fixations towards the face (Fig. 2b) and especially the pelvis (Fig. 2d), but not the chest.

In addition, we found a 3-way interaction between target age, target gender, and group, for the body but not for any specific areas of interest: nonoffending men fixated for more time on adult targets, especially when these targets were female, while members from the other three groups fixated preferentially on adult targets but with similar total fixation duration for both male and female targets (Fig. 2a).

Finally, there was a significant main effect of group (Table 3); planned contrasts revealed that sex offenders against children had significantly longer total duration of fixation than nonsexual offenders, but not offenders against adults or nonoffending men. Regarding specific areas of interest, this main effect of group was found for the chest, but not the face or pelvis (Table 3); planned contrasts showed that offenders against children fixated for a longer mean total time on the chest than offenders against adults and nonsexual offenders, but not nonoffending men.

Table 3.

Response variation in total duration of fixation, for each area of interest.

Effect	**Area of Interest (AOI)**											
	Body			**Face**			**Chest**			**Pelvis**		
Within-subject Effect	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p
TA	**46.76**	**<.001**	**.411**	5.13	.027	.071	**58.18**	**<.001**	**.465**	**35.22**	**<.001**	**.345**
TA * Group	2.55	.063	.102	1.24	.303	.053	**4.89**	**.004**	**.180**	**5.55**	**.002**	**.199**
TG	**17.68**	**<.001**	**.209**	0.61	.436	.009	1.19	.280	.017	**19.95**	**<.001**	**.229**
TG * Group	**6.27**	**.001**	**.219**	0.31	.820	.014	0.92	.437	.040	**4.54**	**.006**	**.169**
TA * TG	**16.75**	**<.001**	**.200**	**7.37**	**.008**	**.099**	4.16	.045	.058	**30.67**	**<.001**	**.314**
TA * TG * Group	**4.19**	**.009**	**.158**	0.96	.415	.041	0.99	.401	.043	3.14	.031	.123
Between-subject Effect	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p
Group	**4.05**	**.010**	**.154**	0.73	.536	.032	**5.64**	**.002**	**.202**	3.03	.035	.120
Planned Contrasts		*p*			*p*			*p*			*p*	
SOAC vs SOAA		.052			.211			**.008**			.948	
SOAC vs NSO		**.009**			.268			**.006**			.182	
SOAC vs NOM		.911			.713			.838			.107	

TA = Target Age, TG= Target gender. SOAC= sexual offenders against children; SOAA =sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men. Results are from mixed-design general linear models (d.f. = 1, 67 for main effects and interactions between TA and TG; 3, 67 for Group or interactions with Group) with Bonferroni adjustment for multiple tests ($\alpha = .0125$). For descriptive statistics, see Table S4 in the Supplementary Materials.

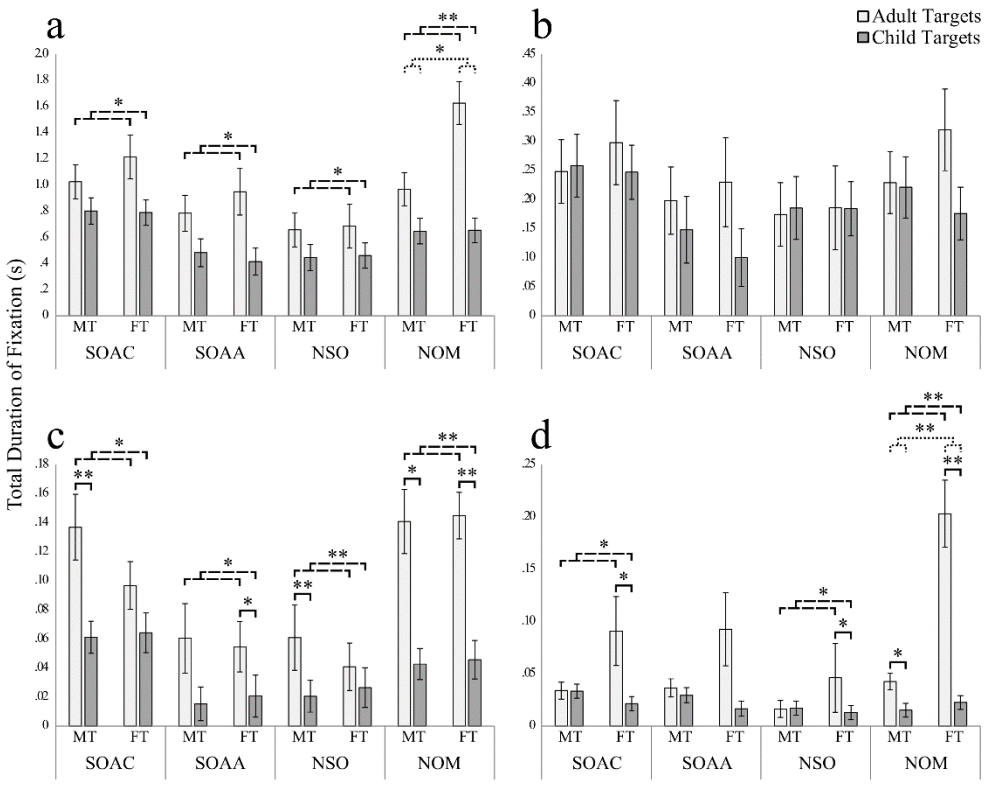

Figure 2. Total duration of fixation. (a) Body; (b) face; (c) chest; (d) pelvis. Results are split by group (SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men), as well as target age (adult targets: white bars; child targets: grey bars) and target gender (MT: male targets; FT: female targets). Bars represent estimated marginal means ±1 SEM. For interactions, dashed lines represent an effect of target age (adult, child), and dotted lines represent and effect of target gender (male, female). Post hoc tests: *p< .0125; **p < .001. For detailed results, see Table S5 (post hoc general linear models) and Table S6 (post hoc *t*-tests) in the Supplementary Results.

Fixation count.

Main effects and interactions are reported on Table 4, with an emphasis on effects and interactions involving target age, reflecting the experimental design.

We found a large main effect of target age, in which participants from every group, tended to fixate on adult targets significantly more times than on child targets (Fig. 2a). For specific areas of interest, this effect was particularly strong when comparing differences in fixations count to adult versus child targets in erotic areas (chest, pelvis; Fig. 3c, 3d), and smaller (and not significant after Bonferroni correction), for the face (Fig. 3b).

Target age also significantly interacted with target gender; when viewing adult targets, participants fixated more times on women than men, while there were no differences in the number of fixations towards child targets (Table 4; Fig. 3a). Looking at specific areas of interest, we found that this same tendency was apparent in fixations towards the face (Fig. 3b) and especially the pelvis (Fig. 2d), but not the chest.

Furthermore, we found a 3-way interaction between target age, target gender and group, for the body but not any specific areas of interest (Table 4): nonoffending men fixated more times on adult targets, especially when these targets were female, while offenders against adults and nonsexual offenders fixated more times on adult targets, but with similar fixation counts for both male and female targets (Fig. 3a). Offenders against children only showed a significant preference for adult compared to child targets when the targets depicted females, and did not have an overall preference for adult targets.

Lastly, as in the case of other attention measurements, we found a significant main effect of group (Table 4); planned contrasts revealed that offenders against children fixated on targets significantly more times than nonsexual offenders, but not more times than offenders against adults or nonoffending men. This main effect of group was driven by differences between groups in the number of fixations on the chest (Table 4); planned contrasts showed that sexual offenders against children fixated more times on the chest than sexual offenders against adults and nonsexual offenders, but not participants from the nonoffending men.

Finally, there was an apparent difference in fixation count towards children between groups, in which offenders against children fixated more times on child stimuli than members of the other three groups (Fig. 3a). When analyzing only attention towards child stimuli, this apparent main effect of group on the number of fixations towards child

stimuli (Fig. 3a) was not significant after Bonferroni correction ($F(3, 67) = 3.20$, $p = .029$, $\eta^2_p = .13$). However, planned contrasts did reveal that sexual offenders against children fixated more times on child stimuli than sexual offenders against adults ($p = .009$) and nonsexual offenders ($p = .011$), but not nonoffending men ($p = .115$). This same tendency was also apparent for the chest (Fig. 3c). Here, there was a main effect of group ($F(3, 67) = 4.27$, $p = .008$, $\eta^2_p = .16$), and planned contrasts showed that sexual offenders against children fixated more times on the chest of child stimuli than sexual offenders against adults ($p = .003$) and non-sexual offenders ($p = .013$, marginally non-significant after Bonferroni correction), but a similar number of times than participant from the nonoffending men group ($p = .40$).

Table 4.
Response variation in fixation count, for each area of interest.

Effect	**Area of Interest (AOI)**											
	Body			**Face**			**Chest**			**Pelvis**		
Within-subject Effect	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p
TA	**62.61**	**<.001**	**.483**	5.31	.024	.073	**92.15**	**<.001**	**.579**	**54.37**	**<.001**	**.448**
TA * Group	1.67	.182	.070	2.20	.096	.090	3.39	.023	.132	3.06	.034	.120
TG	**19.59**	**<.001**	**.226**	0.53	.469	.008	2.34	.131	.034	**29.77**	**<.001**	**.308**
TG * Group	**6.51**	**.001**	**.226**	0.55	.653	.024	1.00	.396	.043	**2.98**	**.037**	**.118**
TA * TG	**19.75**	**<.001**	**.228**	**11.54**	**.001**	**.147**	6.02	.017	.083	**49.50**	**<.001**	**.425**
TA * TG * Group	**4.10**	**.010**	**.155**	0.84	.475	.036	2.13	.104	.087	2.46	.070	.099
Between-subject Effect	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p
Group	**4.32**	**.008**	**.162**	0.66	.577	.029	**6.64**	**.001**	**.229**	1.50	.221	.063
Planned Contrasts		*p*			*p*			*p*			*p*	
SOAC vs SOAA		.036			.293			**.004**			.838	
SOAC vs NSO		**.002**			.220			**.004**			.180	
SOAC vs NOM		.478			.266			.785			.472	

TA = Target Age, TG= Target gender. SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men. Results are from mixed-design general linear models (d.f. = 1, 67 for main effects and interactions between TA and TG; 3, 67 for Group or interactions with Group) with Bonferroni adjustment for multiple tests ($\alpha = .0125$). For descriptive statistics, see Table S7 in the Supplementary Materials.

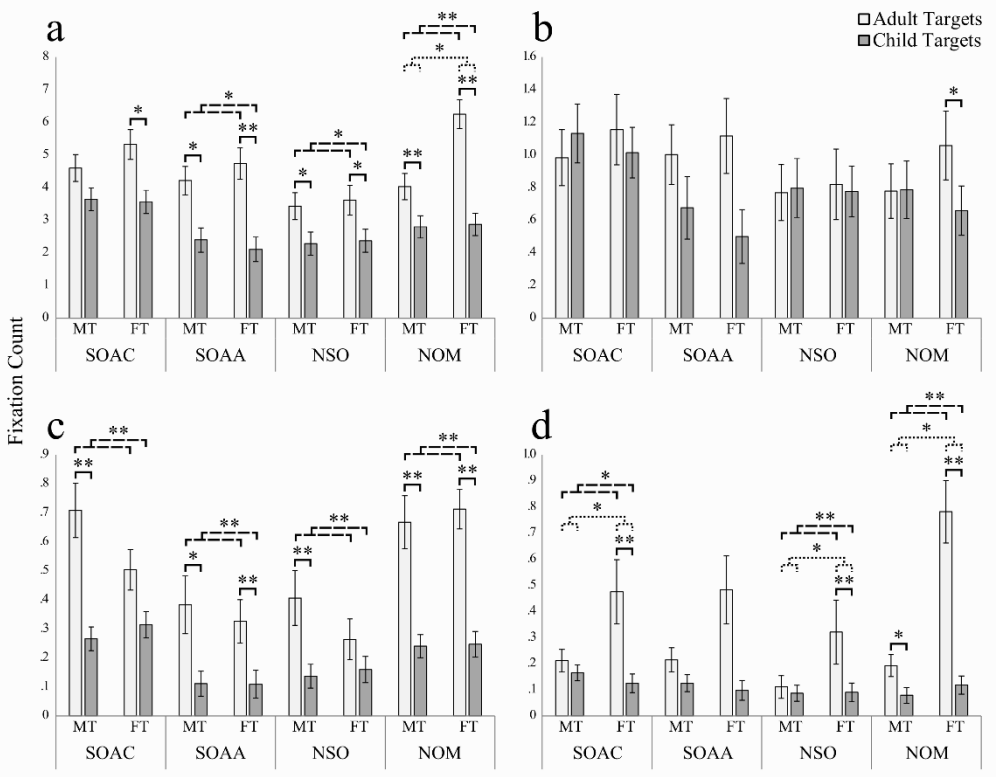

Figure 3. Fixation count. (a) Body; (b) face; (c) chest; (d) pelvis. Results are split by group (SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men), as well as target age (adult targets: white bars; child targets: grey bars) and target gender (MT: male targets; FT: female targets). Bars represent estimated marginal means ±1 SEM. For interactions, dashed lines represent an effect of target age (adult, child), and dotted lines represent and effect of target gender (male, female). Post hoc tests: *p< .0125; **p < .001. For detailed results, see Table S8 (post hoc general linear models) and Table S9 (post hoc *t*-tests) in the Supplementary Results.

5.4.3 Subjective Ratings

Sexual valence and arousal ratings to each stimulus, given by all participants, were analyzed using GLM models, equivalent to those used for eye-tracking data, with target gender and age as within-subject factors, and participant gender and sexual orientation as between-subject factors. Descriptive statistics (means and standard deviations) are provided in Table S10 in the supplementary materials.

For both valence and arousal, the pattern of significant results was the same ($p < .001$ in all cases; Fig. 4); there was a main effect of target age on the valence and arousal

reported by all groups, such that participants rated adult stimuli as more pleasant and more arousing than child stimuli (valence: $F(1, 67) = 36.52$, $\eta 2p = .35$; arousal: $F(1, 67) = 38.53$, $\eta 2p = .37$). Furthermore, there was a main effect of target gender on the valence and arousal reported by all groups, such that participants rated female stimuli as more pleasant and more arousing than male stimuli (valence: $F(1, 67) = 98.55$, $\eta 2p = .60$; arousal: $F(1, 67) = 67.95$, $\eta 2p = .50$). Results also revealed interactions between target gender and target age (valence: $F(1, 67) = 93.42$, $\eta 2p = .58$; arousal: $F(1, 67) = 117.89$, $\eta 2p = .64$) such that participants rated female adult stimuli as more pleasant and more arousing than child or male adult stimuli. Group, on the other hand, had no main effect on the subjective ratings (valence: $F(3, 67) = 1.34$, $p = .27$, $\eta 2p = .06$; arousal: $F(3, 67) = 1.84$, $p = .15$, $\eta 2p = .08$), and did not significantly interact with either target age (valence: $F(3, 67) = 2.04$, $p = .12$, $\eta 2p = .08$; arousal: $F(3, 67) = 1.78$, $p = .16$, $\eta 2p = .07$), target gender (valence: $F(3, 67) = 0.28$, $p = .84$, $\eta 2p = .01$; arousal: $F(3, 67) = 0.77$, $p = .52$, $\eta 2p = .03$), or both target age and target gender (valence: $F(3, 67) = .78$, $p = .51$, $\eta 2p = .03$; arousal: $F(3, 67) = 1.68$, $p = .18$, $\eta 2p = .07$).

Lastly, to test whether viewing patterns are associated with subjective ratings, we examined correlations between the valence and arousal ratings to each stimulus, and each of the eye-tracking early and late attention measurements, for each group (Table S11). These analyses showed that subjective ratings of valence and arousal were associated with late attention, particularly in sexual offenders against adults and nonoffending men.

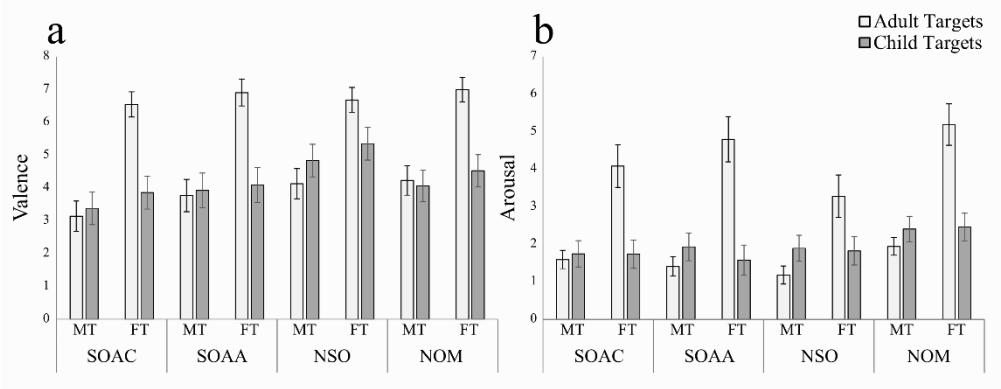

Figure 4. Subjective Sexual Attraction (a) Valence; (b) Arousal; split by group (SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men), as well as target age (adult targets: white bars; child targets: grey bars) and target gender (MT: male targets; FT: female targets). Bars represent estimated marginal means ± 1 S.E.M.

5.5 Discussion

By modifying the version of the eye tracking task developed by Fromberger et al. (2012; 2013; see also, Vásquez-Amézquita et al., 2017) to a free viewing paradigm without specific instruction, we investigated early and late visual attention to the whole body and face, chest, and pelvis child versus adult stimuli, among sexual offenders against children, sexual offenders against adults, nonsexual offenders, and nonoffending men.

The results supported some of our hypotheses: We found evidence that sexual offenders against children show a higher number of first fixations (early attention) towards child stimuli relative to adult stimuli, compared to the other three groups. They also tended to fixate longer and more often (late attention) toward child stimuli than the other two offender groups. Regarding early and late attention to erotic and non-erotic body areas, we found that offenders against children fixated on the chest of women and girls for a similar total number of times and they fixated longer and more frequently on the chest of girls and boys, than the other two groups of offenders.

5.5.1 Early Attention

Contrary to our prediction, we did not find lower latency for the first fixation on child compared to adult stimuli in the offenders against children. Unlike previous studies with pedophilic men (Fromberger et al., 2013) or nonoffending men (Vásquez-Amézquita et al., 2017), there was no significant effect of target age or an interaction between target age and gender on latency to first fixation.

Our results probably differ from Fromberger et al. (2012) because the majority of their participants admitted pedophilic sexual interests and they were clinically evaluated according to diagnostic criteria, whereas we did not have a clinical diagnosis or assessment of pedophilic sexual interests, and many of our offenders against children denied the crime. Despite this limitation, research with other indirect measures (D. Dawson, Barnes-Holmes, Gresswell, Hart, & Gore, 2009; Nunes, Firestone, & Baldwin, 2007; Ó Ciardha & Gormley, 2012) and recently with paradigms of free viewing with eye tracking (Hall et al., 2015), have shown that in groups of sexual offenders against children, without an established diagnosis of pedophilia, there is a cognitive bias towards child stimuli and a gaze pattern differentiated when looking at bodies of boys and girls, especially in the chest area, compared to non-sexual offenders. Therefore, we would expect a differential pattern between our groups, regardless of not being sure of a diagnosis of pedophilia; however, this was not observed for time to first fixation.

Other authors (Attard-Johnson et al., 2016b) identified a low sensitivity of the first fixations in the study by Fromberger et al (Fromberger, Jordan, von Herder, et al., 2012) and specifically the fixation latency (Vásquez -Amézquita et al., 2017) for the effects of sex and the age of the stimuli in samples of gynephilic and androphilic men and women without pedophile sexual interests. Therefore, given the nature of the stimuli presented,

the social desirability factor could be present in all groups. However, it could have influenced the manipulation of the natural ocular response, especially those who denied their sexual offense, given latency of fixation is not completely free from top-down control. This could explain why there was no main effect, nor any significant interactions of age, for time to first fixation in any of the four groups. We observed participants who kept looking at the center of the screen in some stimuli, avoiding or delayed fixating on either stimulus (Table S12). It is possible that even adult sexual offenders and non-sexual offenders would bias their attention equally to children and adults, concerned about what their responses might signify. Though the data were collected for research purposes only and not shared with the prison, the offenders might still have been suspicious about the results of the task (for further data and discussion, see the Supplementary Discussion).

In relation to the number of first fixations, there was a significant tendency to fixate first on adults more frequently than on children, especially in sexual offenders against adults, consistent with previous findings in non-pedophilic men (Fromberger, Jordan, von Herder, et al., 2012). Previous research (Fromberger et al., 2013) showed that pedophilic men have an inverse pattern, and tended to fixate more first times on child compared to adult stimuli; consistent with this, we found a significant interaction between target age and group, in which the only group that tended to fixate more first times on child than adult stimuli were sexual offenders against children (Fig. 1).

It is possible that early attention captured by sexually relevant stimuli may be better indicated by the number of first fixations than by fixation latency; the number of first fixations could be less susceptible to voluntary control. Nummenmaa et al. (Nummenmaa et al., 2006) argue that fixation latencies greater than 175ms (typical duration of a reflexive saccadic movement) are not entirely automatic. Participants could have inhibited and delayed their first fixation towards the stimuli because of social

desirability. However, the number of first fixations seems to indicate that participants peripherally perceived some of the image content.

5.5.2 Late Attention

We expected a longer total duration of fixations and a greater number of fixations towards child bodies by offenders against children, in comparison with the other three groups. We found higher total duration of fixations for the body of adults than for children in all groups, consistent with the findings of Fromberger et al. (Fromberger et al., 2013), in which both pedophilic and non-pedophilic participants showed a longer relative fixation time towards adults than children. In our study, only the nonoffending men group showed significantly higher total duration of fixations to adult female stimuli than to male adults, boys or girls, consistent with previous studies (Fromberger, Jordan, von Herder, et al., 2012; Vásquez-Amézquita et al., 2017). However, no effect of target gender was found for the three offender groups, who fixated on adult men and women for a similar total time. Rather than suggesting bisexual interests, this result may be due to the fact that some participants avoided looking at child stimuli and therefore looked at adult men and women similarly (Cima et al., 2003).

In both the total duration of fixations and the fixation count for the whole body, sexual offenders against children tended to fixate longer and more often on child stimuli than the other two offender groups, and they were the only group in which there was no main effect of target age. This result is congruent with Fromberger et al. (Fromberger et al., 2013) who found a greater duration of fixations on child stimuli in pedophilic men, even though all participants looked at adult bodies longer. It is important to note that Fromberger et al. (Fromberger et al., 2013) analyzed relative duration, rather than

absolute fixation duration as we did in this study (for further discussion and an explanation of why we analyzed absolute duration, see the Supplementary Discussion).

Regarding specific areas of the body, we found that late attention was maintained longer and more often on erotic areas (chest and pelvis) of adult women stimuli in all four groups, congruent with previous evidence (Dixson et al., 2011; Fromberger, Jordan, von Herder, et al., 2012; Hewig, Trippe, Hecht, Straube, & Miltner, 2008; Vásquez-Amézquita et al., 2017, 2018). In terms of the face, both offenders against adults and nonoffending men showed a tendency to fixate longer and more often on the faces of adult women compared to girls, as expected (Hewig et al., 2008; Proverbio, 2017; Rupp & Wallen, 2007), whereas the offenders against children and nonsexual offenders showed no difference for faces of women versus girls.

Our results are consistent with Fromberger et al. (Fromberger et al., 2013), who also found that offenders against children looked equally at faces of adults and children; however, they did not see this pattern for nonsexual offenders. In this regard, results are consistent with Vásquez-Amézquita et al. (Vásquez-Amézquita et al., 2017), who also found that the face, though the most observed body region, was not associated with gender interests, unlike the chest or pelvis regions, which include important cues of sexual maturity and reproductive potential (Coy, Green, & Price, 2014; Jasienska, Ziomkiewicz, Ellison, Lipson, & Thune, 2004).

Participants from all groups looked longer and more often at adult than at child chests, as expected for heterosexual men (Lykins et al., 2008; Rupp & Wallen, 2007; Suschinsky, Elias, & Krupp, 2007). However, the difference between fixations on the chest of women and girls was not significant among offenders against children, and they fixated longer and more frequently on the chest of girls and boys, than the other two

criminal groups, consistent with recent research (Hall et al., 2015). The chest region can quickly signal the sexual maturity of targets, so these results support the idea that offenders against children differ from other men in their response to child stimuli (Dixson, Duncan, & Dixson, 2015; Dixson et al., 2011; Hewig et al., 2008; Jasienska et al., 2004; Krupp, 2008; Seto, 2017).

In relation to the pelvic region, all groups looked longer and more often at the pelvis of adult men and women than of children, consistent with previous results from heterosexual men (Lykins et al., 2008; Rupp & Wallen, 2007; Suschinsky et al., 2007). As expected, the nonoffending men group fixated significantly more and more times on the pelvis of adult women versus girls, and on the pelvis of men compared to boys (Vásquez-Amézquita et al., 2017). The viewing time for this area in the other three groups was very short compared to the nonoffending men, and none of these three groups distinguished between adult men and boys. Contrary to what was expected according to previous research (Fromberger et al., 2013), offender against children did not look relatively longer at the pelvis region of child stimuli when compared to other groups.

Correlations between subjective ratings and visual attention were strongest for the nonoffenders, followed by the sexual offenders against adults. As expected, we found almost no significant association between fixation patterns and subjective ratings in the group of sexual offenders against children (except a significant correlation between arousal and fixation count), given that two-thirds of these individuals denied the sexual crime and would have denied any sexual interest in children. Surprisingly, we also found no significant correlations for nonsexual offenders; one possibility is that they avoided rating either adult or child stimuli positively because they were suspicious about the intent of the task.

5.6 Strengths and Limitations

In our version of the experimental paradigm used by Fromberger et al. (Fromberger et al., 2013), the viewing of images was free and no question was asked about the attractiveness of the images during the experiment, to reduce the likelihood that participants would infer the full purpose of the study. However, the presentation of competing adult and child stimuli may still have allowed participants to infer the objective of the study and encouraged some to manipulate their responses in socially desirable ways. To reduce this possibility, future studies using this paradigm could include non-sexual and emotionally neutral stimuli, which has been useful in experiments using sexual stimuli (Nummenmaa et al., 2006), and investigating atypical sexual preferences (Jordan et al., 2016).

Time to first fixation, total duration of fixations, and fixation count on the entire body were not sensitive enough to discriminate between the four groups, possibly because incarcerated offenders behaved in a socially desirable way, even though they were assured that the results would not affect them (Cima et al., 2003). This is relevant, given that in contrast to previous research (Fromberger et al., 2013; Fromberger, Jordan, Steinkrauss, et al., 2012; Jordan et al., 2016, 2018), only 10 of the participants in the two sexual offender groups in our study admitted committing the crime for which they were convicted, and some participants in all three offender groups expressed concern that the evaluation might have some effect on their legal process, although it was explicitly stated in the informed consent process that this was not the case.

According to Trottier, Rouleau, Renaud, and Goyette (Trottier, Rouleau, Renaud, & Goyette, 2014), a significant reduction in the frequency of fixations during the evaluation process would reflect attempts to lie on the part of the participant, and this

decrease in the frequency of fixation in order to inhibit the sexual response could be due to covert attention of the participant to cognitively distract from the content of the stimulus, triggering a short exploration of the stimulus. This happened in our study, because offenders differed from nonoffending participants in the duration and number of fixations on entire body, and especially erotic areas, suggesting that there may have been a desire to lie or manipulate their response in socially acceptable ways. Future studies could include measures of social desirability and also offer further ways of assuring participants that the data could not be linked to them individually.

Another limitation is that our stimuli depicted children and adults in swimsuits, thereby obscuring the potent maturity cue of genital appearance. However, the different ages/maturity categories of our stimuli were still signaled by other cues, such as facial features, absence or presence of breasts, and overall body shape and size. As reported in previous studies (Vásquez-Amézquita et al., 2017), early attention is attracted by the body gestalt, and then it is directed towards erotic areas relevant to reproduction, such as the chest or pelvis regions (Coy et al., 2014; Hewig et al., 2008; Jasienska et al., 2004). Because pictures were shown, rather than videos, psychological characteristics that might also be relevant (e.g., innocence, playfulness) were not systematically manipulated. All our participants reported having a heterosexual orientation, denying sexual interest toward same sex adults or children. It would be interesting to see what impact target gender would have in a future study that included non-heterosexual participants.

Our main limitation was not being able to identify pedophilic offenders against children, given many sexual offenders against children are not pedophilic (Seto, 2008, 2013). We used responses to a children and sex cognition questionnaire to screen participants who had committed a sexual offense against a child, but this was, at best, a correlate of pedophilic sexual interests. As noted, we did not have diagnostic or

assessment information to identify pedophilic offenders, prison file information was sparse, and a majority of the offenders against children denied their crime and presumably would not have admitted a sexual interest in children. The explanation for why our results differ from Fromberger et al. (2012, 2013) is that the effect sizes obtained here were diluted by the inclusion of data from nonpedophilic sexual offenders against children. However, it is important to consider that other studies using indirect measures (D. Dawson et al., 2009; Nunes et al., 2007; Ó Ciardha & Gormley, 2012) and recently preliminary evidence with free viewing eye tracking (Hall et al., 2015) have detected cognitive bias toward children and different gaze patterns in convicted heterosexual offenders against children without pedophilia, compared with non-offending men. Future research using a similar experimental design, but comparing pedophilic and nonpedophilic participants, would advance work in this area. We would expect larger effects in this kind of comparison.

The comparison of the groups is limited in relation to the certainty of the commission of offenses in the two sex offender groups, given that the offense information was obtained from the institutional records of the participant, and in most cases did not coincide with his self-report. However, it is highly probable in penitentiary contexts to deny the commission of sexual offense without this implying a false conviction (O'Donohue & Letourneau, 1993).

Prior to the beginning of this investigation, we conducted an anonymous survey of 700 men convicted of sexual offenses, of which only 96 prisoners admitted having committed the offense for which they were convicted. It is highly implausible that the percentage of false convictions exceeds 80% in a national legal system. What we know is that the stigma about sexual offenses is greater than for other offenses, especially

among prisoners, which we think leads to denial of the commission of the offense, even under guarantees of confidentiality (Robbers, 2009; Tewksbury, 2012).

The stigma encouraging denial may even be stronger in South America, compared to countries such as Canada, the United States, or the United Kingdom, where there have been many studies of pedophilia and sexual offending. This is evidenced by the fact that we were unable to find any experimental scientific papers about pedophilia and sexual offenders against children in South American samples, despite the high prevalence of sexual offenses against children among Latin-Americans (Arreola, Neilands, Pollack, Paul, & Catania, 2005; Balsam, Lehavot, Beadnell, & Circo, 2010; Newcomb, Munoz, & Carmona, 2009). We believe that these results are valuable because we provide the first experimental results for a Southern American sample, where research using eye tracking methodology in these type of forensic samples is lacking. Given that each culture outlines what is normal or deviant, legal or illegal, the development of pedophilia and sexual offending against children may be affected by multiple factors associated with culture, and generalizing experimental findings across different cultures can be problematic.

If sexual interest toward children is linked to culture, the science should discuss conceptual aspects and perform cross-cultural studies related to their diagnosis and prevalence. Having data from different geographical regions, including South America, would be relevant. A few studies (Carballo-Diéguez, Balan, Dolezal, & Mello, 2012; Dolezal et al., 2014; Dolezal & Carballo-Dieguez, 2002) have reported differences across South American countries, such as Colombia, Brazil and Argentina, which have different cultural norms about sexuality than those predominant in Europe or the U.S., in early sexual experiences and childhood sexual abuse rate among men, and especially in whether they label them as sexual abuse. These findings show that a higher rate of Latin American men have had early atypical sexual experiences compared with men of other regions. In

fact, the majority of men report some kind of manual, oral, genital, or anal contact prior to age 13 with an older partner, but most of them do not label it as sexual abuse, and the majority did not view this experience negatively. These differences indicate that the concepts of child sexual abuse may vary widely from country to country (Carballo-Diéguez et al., 2012), and influence the tolerance or stigmatization of this topic, and the legal systems that regulate criminal sexual behavior. We believe that this line of research opens a scientifically and socially promising area for future studies in South American countries like Colombia.

One potential limitation of our study, could be related to statistical power to detect effects previously found (Fromberger et al., 2013; Fromberger, Jordan, von Herder, et al., 2012). However, our study has an adequate sample size to detect previously reported effects (for a comparison, see Table S13 in the Supplementary Materials). The main difference is that, while in related studies (Fromberger et al., 2013; Fromberger, Jordan, von Herder, et al., 2012) effects tended to be moderate to large, the effects reported here tended to be small to moderate, which could be due to differences in the design and evaluated groups.

Although the eye tracking methodology could be useful in identifying sexual preferences and, in our case, in differentiating sexual offenders against children from other offenders, we found that this technique is not sensitive enough to measure involuntary behavior, given the susceptibility of eye movements to top-down control. Therefore, it should be used only as a complementary measure in the diagnostic of atypical sexual preferences, like pedophilia. Finally, another limitation of the technique itself, is that not all persons are apt to participate, given the difficulty in the eye calibration of participants with visual deficits.

5.7 Conclusions

Our results show there are differences in early and late visual attention of sexual offenders against children – in comparison to sexual offenders against adults, nonsexual offenders, and nonoffending men – for sexually immature (child) and mature (adult) stimuli. This study adds to the scarce research using eye-tracking techniques in samples of child sex offenders. It extends recent studies with child sex offenders (Fromberger et al., 2013; Hall et al., 2015), by comparing them to sex offenders against adults, in addition to nonsexual offenders or nonoffending men. Also, in contrast to previous studies (Fromberger et al., 2013; Fromberger, Jordan, Steinkrauss, et al., 2012), we used a free attention paradigm and we explored the precise location of fixations on sexually relevant body areas.

Our results provide mixed support for the usefulness of free viewing eye-tracking as an experimental paradigm, when viewing competing stimuli, as proposed by Fromberger (Fromberger et al., 2013; Fromberger, Jordan, von Herder, et al., 2012) in the assessment of sexual interest in children. Taking into account that most of our participants denied the commission of the crime and were not evaluated clinically to determine if they have pedophilia, we found that the most sensitive parameters to measure attentional biases towards immature sexual stimuli were the number of first fixations to measure early attention, and the duration and number of fixations on specific sexual areas, such as the chest region (Hall et al., 2015), to measure late attention.

5.8 Supplementary materials

5.8.1 Supplementary Results

Early Attention

Table S1.
Descriptive statistics for time for first fixation (TFF) and number of first fixations (FF) according to target age and gender.

Measurement	Group	*n*	Target							
			Adult				Child			
			Male		Female		Male		Female	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
TFF	SOAC	18	1.09	0.28	1.11	0.27	1.03	0.27	1.01	0.28
	SOAA	16	1.21	0.49	1.28	0.50	1.28	0.43	1.18	0.40
	NSO	18	1.29	0.44	1.45	0.44	1.30	0.43	1.25	0.43
	NOM	19	0.98	0.34	0.90	0.30	1.01	0.25	0.99	0.30
FF	SOAC	18	7.78	3.39	6.89	2.76	8.39	5.12	9.39	4.54
	SOAA	16	6.94	5.22	6.75	4.81	4.69	3.74	4.56	3.88
	NSO	18	5.22	3.69	5.28	4.32	5.61	3.40	5.44	4.62
	NOM	19	10.63	4.42	11.63	4.98	9.16	3.88	9.74	4.34

Descriptive statistics (mean and standard deviation) for time to first fixations (TFF) and mean number of first fixations (FF) and Group (SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO =nonsexual offenders; NOM = nonoffending men).

Table S2.
Time to first fixation (TFF) and number of first fixation (FF): post-hoc comparison target gender and age for each participant group.

Group	Effect	d.f.	Time to First Fixation			Number of First Fixations		
			F	*p*	η^2_p	*F*	*p*	η^2_p
Sexual offenders against children	TA	1, 17	2.152	.161	0.112	3.367	.084	0.165
	TG	1, 17	0.025	.875	0.001	0.015	.903	0.001
	TA * TG	1, 17	0.342	.566	0.020	3.666	.073	0.177
Sexual offenders against adults	TA	1, 15	0.081	.780	0.005	**16.644**	**.001**	**0.526**
	TG	1, 15	0.067	.799	0.004	0.288	.600	0.019
	TA * TG	1, 15	3.557	.079	0.192	0.006	.941	0.000
Nonsexual offenders	TA	1, 17	1.443	.246	0.078	0.436	.518	0.025
	TG	1, 17	0.506	.486	0.029	0.016	.899	0.001
	TA * TG	1, 17	3.784	.068	0.182	0.031	.863	0.002
Nonoffending men	TA	1, 18	0.733	.403	0.039	4.310	.053	0.193
	TG	1, 18	2.003	.174	0.100	2.150	.160	0.107
	TA * TG	1, 18	0.551	.467	0.030	0.146	.707	0.008

Results are from repeated-measures GLMs for each Group. Showing main effects of Target Gender (TG) and Target Age (TA) and their interaction for time to first fixation (TFF) and number first fixations (FF). Significant effects are in bold.

Table S3.
Time to first fixation (TFF) and number of first fixation (FF): post-hoc comparison of male versus female targets

Measurement		Group											
		Sexual offenders against children			Sexual offenders against adults			Nonsexual offenders			Nonoffending men		
		t	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*
TFF	MT	0.91	17	.374	-0.87	15	.400	-0.05	17	.962	-0.32	18	.755
	FT	1.65	17	.118	1.30	15	.212	2.24	17	.038	-1.21	18	.244
FF	MT	-0.62	17	.544	**3.25**	**15**	**.005**	-0.57	17	.579	2.11	18	.049
	FT	-2.57	17	.020	**3.22**	**15**	**.006**	-0.20	17	.842	1.58	18	.132

Results are from paired-samples t-tests comparing time to first fixations (TFF) and mean number of first fixations (FF) to adult versus child targets in male (MT) and female (FT) targets with Bonferroni adjustment for multiple tests ($\alpha = .0125$). Significant differences are in bold.

Late Attention

Table S4

Descriptive statistics for time to total duration of fixation (TDF) according to target age and gender.

Area of Interest (AOI)	Group	*n*	Target							
			Adult				Child			
			Male		Female		Male		Female	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Body	SOAC	18	1.02	0.49	1.21	0.65	0.80	0.42	0.79	0.42
	SOAA	16	0.78	0.44	0.95	0.61	0.48	0.41	0.41	0.37
	NSO	18	0.66	0.54	0.68	0.57	0.45	0.41	0.46	0.42
	NOM	19	0.97	0.68	1.63	0.93	0.65	0.47	0.65	0.43
Face	SOAC	18	0.25	0.27	0.30	0.36	0.26	0.23	0.25	0.21
	SOAA	16	0.20	0.21	0.23	0.32	0.15	0.19	0.10	0.14
	NSO	18	0.17	0.23	0.19	0.25	0.19	0.25	0.18	0.26
	NOM	19	0.23	0.21	0.32	0.28	0.22	0.24	0.18	0.15
Chest	SOAC	18	0.14	0.11	0.10	0.08	0.06	0.08	0.06	0.10
	SOAA	16	0.06	0.07	0.05	0.04	0.02	0.02	0.02	0.02
	NSO	18	0.06	0.05	0.04	0.04	0.02	0.02	0.03	0.02
	NOM	19	0.14	0.13	0.14	0.09	0.04	0.03	0.05	0.04
Pelvis	SOAC	18	0.03	0.04	0.09	0.08	0.03	0.03	0.02	0.02
	SOAA	16	0.04	0.04	0.09	0.16	0.03	0.04	0.02	0.03
	NSO	18	0.02	0.02	0.05	0.04	0.02	0.02	0.01	0.02
	NOM	19	0.04	0.04	0.20	0.21	0.02	0.02	0.02	0.04

Descriptive statistics (mean and standard deviation) for time to total duration of fixation for each area of interest and Group (SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO =nonsexual offenders; NOM = nonoffending men)

Table S5.
Total duration of fixation (TDF): post-hoc comparison target gender and age for each participant group.

Group	Effect	d.f.	Body			Face			Chest			Pelvis		
			F	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p
Sexual offenders against children	TA	**1, 17**	**8.114**	**.011**	**0.323**	0.195	.664	0.011	**15.087**	**.001**	**0.470**	**9.812**	**.006**	**0.366**
	TG	1, 17	2.375	.142	0.123	0.456	.509	0.026	1.976	.178	0.104	6.776	.019	0.285
	TA * TG	1, 17	1.962	.179	0.103	0.731	.404	0.041	2.769	.114	0.140	**13.817**	**.002**	**0.448**
Sexual offenders against adults	TA	**1, 15**	**14.237**	**.002**	**0.487**	3.114	.098	0.172	**10.710**	**.005**	**0.417**	5.256	.037	0.259
	TG	1, 15	2.536	.132	0.145	0.326	.577	0.021	0.001	.977	0.000	1.828	.196	0.109
	TA * TG	1, 15	4.551	.050	0.233	1.724	.209	0.103	1.257	.280	0.077	4.178	.059	0.218
Nonsexual offenders	TA	**1, 17**	**8.026**	**.011**	**0.321**	0.038	.848	0.002	**20.670**	**<.001**	**0.549**	**10.546**	**.005**	**0.383**
	TG	1, 17	1.729	.206	0.092	0.216	.648	0.013	2.189	.157	0.114	5.345	.034	0.239
	TA * TG	1, 17	0.242	.629	0.014	0.321	.578	0.019	6.388	.022	0.273	**16.019**	**.001**	**0.485**
Nonoffending men	TA	**1, 18**	**18.728**	**<.001**	**0.510**	4.407	.050	0.197	**23.762**	**<.001**	**0.569**	**18.399**	**<.001**	**0.505**
	TG	1, 18	13.899	**.002**	0.436	0.435	.518	0.024	0.085	.773	0.005	**11.989**	**.003**	**0.400**
	TA * TG	**1, 18**	**12.208**	**.003**	**0.404**	**8.118**	**.011**	**0.311**	0.002	.965	0.000	**12.936**	**.002**	**0.418**

Results are from repeated-measures GLMs for each area of interest (AOI) and Group. Showing main effects of Target Gender (TG) and Target Age (TA) and their interaction for total duration of fixation (TDF). Significant effects are in bold.

Table S6.
Total duration of fixation (TDF): post-hoc comparison of male versus female targets

Area of Interest (AOI)		Group											
		Sexual offenders against children			Sexual offenders against adults			Nonsexual offenders			Nonoffending men		
		t	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*
Body	MT	0.91	17	.374	-0.87	15	.400	-0.05	17	.962	-0.32	18	.755
	FT	1.65	17	.118	1.30	15	.212	2.24	17	.038	-1.21	18	.244
Face	MT	-0.26	17	.800	1.08	15	.295	-0.53	17	.602	0.26	18	.796
	FT	0.69	17	.497	1.85	15	.083	0.05	17	.961	2.71	18	.014
Chest	MT	**5.09**	**17**	**<.001**	2.77	15	.014	**5.20**	**17**	**<.001**	**3.90**	**18**	**.001**
	FT	1.45	17	.165	**3.88**	**15**	**.001**	1.78	17	.092	**4.64**	**18**	**<.001**
Pelvis	MT	0.06	17	.954	0.90	15	.380	-0.20	17	.842	**3.31**	**18**	**.004**
	FT	**3.96**	**17**	**.001**	2.23	15	.042	**3.92**	**17**	**.001**	**4.02**	**18**	**<.001**

Results are from paired-samples t-tests comparing total duration of fixation (TDF) to adult versus child targets in male (MT) and female (FT) targets for each area of interest with Bonferroni adjustment for multiple tests (α = .0125). Significant differences are in bold.

*T*able S7.
Descriptive statistics for fixations count (FC) according to target age and gender.

Area of Interest (AOI)	Group	*n*	Target							
			Adult				Child			
			Male		Female		Male		Female	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Body	SOAC	18	4.60	1.60	5.32	1.88	3.64	1.25	3.56	1.34
	SOAA	16	4.21	1.77	4.74	2.15	2.39	1.64	2.11	1.54
	NSO	18	3.43	1.74	3.61	1.76	2.28	1.46	2.37	1.55
	NOM	19	4.03	1.85	6.25	1.94	2.80	1.59	2.88	1.55
Face	SOAC	18	0.98	0.67	1.15	0.87	1.13	0.78	1.01	0.71
	SOAA	16	1.00	0.98	1.12	1.32	0.68	0.81	0.50	0.53
	NSO	18	0.77	0.67	0.82	0.72	0.80	0.84	0.78	0.84
	NOM	19	0.78	0.56	1.06	0.69	0.79	0.64	0.66	0.48
Chest	SOAC	18	0.71	0.44	0.50	0.38	0.27	0.22	0.31	0.30
	SOAA	16	0.38	0.36	0.33	0.16	0.11	0.16	0.11	0.09
	NSO	18	0.41	0.25	0.26	0.23	0.14	0.13	0.16	0.11
	NOM	19	0.67	0.49	0.71	0.35	0.24	0.17	0.25	0.19
Pelvis	SOAC	18	0.21	0.22	0.48	0.36	0.16	0.16	0.13	0.14
	SOAA	16	0.21	0.22	0.48	0.76	0.13	0.15	0.10	0.15
	NSO	18	0.11	0.13	0.32	0.25	0.09	0.10	0.09	0.12
	NOM	19	0.19	0.16	0.78	0.58	0.08	0.09	0.12	0.18

Descriptive statistics (mean and standard deviation) for fixation count for each area of interest and Group (SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO =nonsexual offenders; NOM = nonoffending men).

Table S8.
Fixation count (FC): post-hoc comparison target gender and age for each participant group.

Group	Effect	d.f.	Body			Face			Chest			Pelvis		
			F	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p	*F*	*p*	η^2_p
Sexual offenders against children	TA	1, 17	7.235	.016	0.299	0.001	.973	0.000	**20.134**	**<.001**	**0.542**	**11.471**	**.004**	**0.403**
	TG	1, 17	4.180	.057	0.197	0.323	.577	0.019	2.363	.143	0.122	**8.567**	**.009**	**0.335**
	TA * TG	1, 17	2.969	.103	0.149	3.823	.067	0.184	4.730	.044	0.218	**16.839**	**.001**	**0.498**
Sexual offenders against adults	TA	**1, 15**	**16.481**	**.001**	**0.524**	3.700	.074	0.198	**21.003**	**<.001**	**0.583**	6.859	.019	0.314
	TG	1, 15	3.001	.104	0.167	0.513	.485	0.033	0.446	.514	0.029	2.230	.156	0.129
	TA * TG	1, 15	4.456	.052	0.229	1.392	.256	0.085	1.427	.251	0.087	4.424	.053	0.228
Nonsexual offenders	TA	**1, 17**	**9.105**	**.008**	**0.349**	0.005	.945	0.000	**20.979**	**<.001**	**0.552**	**20.317**	**<.001**	**0.544**
	TG	1, 17	1.941	.182	0.102	0.069	.796	0.004	3.305	.087	0.163	11.518	**.003**	0.404
	TA * TG	1, 17	0.194	.665	0.011	0.707	.412	0.040	5.840	.027	0.256	**22.505**	**<.001**	**0.570**
Nonoffending men	TA	**1, 18**	**46.249**	**<.001**	**0.720**	7.056	.016	0.282	**36.473**	**<.001**	**0.670**	**30.945**	**<.001**	**0.632**
	TG	**1, 18**	**13.519**	**.002**	**0.429**	0.961	.340	0.051	0.230	.637	0.013	**17.416**	**.001**	**0.492**
	TA * TG	**1, 18**	**14.728**	**.001**	**0.450**	**10.508**	**.005**	**0.369**	0.152	.702	0.008	**25.785**	**<.001**	**0.589**

Results are from repeated-measures GLMs for each area of interest (AOI) and Group. Showing main effects of Target Gender (TG) and Target Age (TA) and their interaction for fixation count (FC). Significant effects are in bold

Table S9
Fixation Count (FC): post-hoc comparison of male versus female targets

Area of Interest (AOI)		Group											
		Sexual offenders against children			Sexual offenders against adults			Nonsexual offenders			Nonoffending men		
		t	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*	*t*	d.f.	*p*
Body	MT	2.00	17	.062	**3.42**	**15**	**.004**	**2.85**	**17**	**.011**	**4.61**	**18**	**<.001**
	FT	**2.82**	**17**	**.012**	**4.20**	**15**	**<.001**	**2.98**	**17**	**.008**	**6.03**	**18**	**<.001**
Face	MT	-1.18	17	.252	1.37	15	.191	-0.26	17	.796	-0.11	18	.910
	FT	0.84	17	.411	2.02	15	.062	0.33	17	.745	**3.42**	**18**	**.003**
Chest	MT	**5.66**	**17**	**<.001**	**3.88**	**15**	**.001**	**4.72**	**17**	**<.001**	**4.64**	**18**	**<.001**
	FT	1.84	17	.084	**5.06**	**15**	**<.001**	2.13	17	.048	**5.51**	**18**	**<.001**
Pelvis	MT	0.78	17	.445	2.30	15	.036	1.30	17	.210	**3.15**	**18**	**.006**
	FT	**4.52**	**17**	**<.001**	2.45	15	.027	**4.92**	**17**	**<.001**	**5.54**	**18**	**<.001**

Results are from paired-samples t-tests comparing fixation count (CF) to adult versus child targets in male (MT) and female (FT) targets for each area of interest with Bonferroni adjustment for multiple tests (α = .0125). Significant differences are in bold.

Subjective Ratings

Table S10
Descriptive statistics for Subjective valence and sexual arousal.

	Group	*n*	Target							
			Adult				Child			
			Male		Female		Male		Female	
			M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Valence	SOAC	18	3.14	1.99	6.55	1.99	3.38	2.01	3.86	1.98
	SOAA	16	3.77	2.04	6.91	1.84	3.93	2.17	4.09	2.14
	NSO	18	4.13	1.91	6.68	1.20	4.83	2.23	5.35	2.27
	NOM	19	4.23	1.89	6.99	1.41	4.06	2.02	4.52	2.12
Arousal	SOAC	18	1.59	0.88	4.08	2.12	1.74	0.82	1.74	0.85
	SOAA	16	1.41	0.57	4.79	2.78	1.93	1.34	1.58	0.87
	NSO	18	1.18	0.44	3.28	2.44	1.89	1.72	1.82	2.02
	NOM	19	1.94	1.65	5.19	2.29	2.40	1.79	2.46	2.11

Descriptive statistics (mean and standard deviation), for subjective valence and sexual arousal, and Group (SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO =nonsexual offenders; NOM = nonoffending men).

Table S11
Correlations between subjective ratings and early and late attention

	Group							
	SOAC		SOAA		NSO		NOM	
	Valence	*Arousal*	*Valence*	*Arousal*	*Valence*	*Arousal*	*Valence*	*Arousal*
Early attention								
Number of first fixations	.15	-.05	.02	.16	-.11	.10	.11	**.30****
Time to first of fixation	.00	.10	-.09	-.20	.18	.07	.00	-.18
Late attention								
Total duration of fixation	.22	.18	**.26***	**.42*****	-.05	.06	**.26***	**.33****
Fixation count	.22	**.26***	**.33****	**.37****	.09	.21	**.29***	**.34****

Correlation statistics (Pearson Coefficient), between subjective valence and sexual arousal, and early and late attention for each Group (SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO =nonsexual offenders; NOM = nonoffending men; n = 72, 64, 72 and 76 for each group, respectively), towards all stimuli. Significant correlations are in bold: *$p < .05$; ** $p < .01$; ***$p < .001$.

Table S12

Comparison between groups of the proportion of stimuli not observed by participants, or with latencies longer than 175ms.

Group Comparison	Proportion of unobserved stimuli			Proportion of stimuli with latencies > 175ms		
	χ^2	d.f.	*p*	χ^2	d.f.	*p*
All	**42.05**	**3**	**<.001**	**12.00**	**3**	**0.007**
NOM vs SOAC	0.18	1	0.67	3.70	1	0.05
NOM vs SOAA	**13.45**	**1**	**<.001**	0.49	1	0.48
NOM vs NSO	**28.47**	**1**	**<.001**	**9.01**	**1**	**0.003**
SOAC vs SOAA	**9.49**	**1**	**0.002**	1.04	1	0.31
SOAC vs NSO	**22.87**	**1**	**<.001**	0.87	1	0.35
SOAA vs NSO	2.66	1	0.10	4.53	1	0.03

Results represent χ^2 tests for equality of proportions (All = 4-sample test comparing proportions across the four groups). For specific comparisons between two groups, $\alpha = .0083$, because we performed six *post-hoc* comparisons. The proportion of unobserved stimuli was: SOAC = .25, SOAA = .53, NSO = .69, and NOM = .20. Proportion of stimuli with latencies > 175ms was: SOAC = .30, SOAA = .20, NSO = .39, and NOM = .14. SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men.

Table S13

Sample size calculation based on comparable measurements for a main effect of target age between Fromberger et al (2012, 2013) and this study.

Study	Groups	Total sample size	Measurement	*F*	d.f.	η^2_p	Total sample size requirement
Fromberger et al. (2012)	(1) Non-pedophilic men	12	FF	11.14	1. 11	.503	8
			TFF	-	-	-	-
			TDF	36.30	1. 11	.767	5
Fromberger et al. (2013)	(3) Pedophilic, non-sexual offenders, general population	82	FF	-	-	-	-
			TFF	14.72	1. 77	.160	27
			TDF	1253.62	1. 77	.942	6
This study	(4) SOAC, SOAA, NSO, NOM	71	FF	2.22	1. 67	.032	-
			TFF	1.03	1. 67	.015	-
			TDF	46.76	1. 67	.411	-

Total sample size, represents the sum of all participants in all groups for each study. Total sample size requirement to detect an effect of that size, with a power (1 - β error probability) of .95, was calculated using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) version 3.1.9.2 based on the effect size (η^2_p), for an $\alpha = .0125$, due to our adjustment for multiple tests. FF = number of first fixations; TFF = time to first fixation; TDF = total duration of fixations. SOAC = sexual offenders against children; SOAA = sexual offenders against adults; NSO = nonsexual offenders; NOM = nonoffending men. All comparisons are based on fixations over the entire body. For interpretation of effect sizes, the benchmarks

for small, medium, and large effect sizes are, respectively, .0099, .0588, and .1379 (Cohen, 1988; Richardson, 2011).

5.8.2 Supplementary Discussion

Proportion of stimuli not observed by participants

In all four study groups, we found at least one participant who avoided looking at any of the two stimuli presented simultaneously on the screen. The percentage of images for which at least one participant avoided looking at any of the two competing stimuli was as follows: sexual offenders against children, 25%; sexual offenders against adults, 53%; nonsexual offenders, 68%; and nonoffending men, 20%. This proportion of unobserved stimuli was significantly different across the four groups (Table S12). Using the group of nonoffending men as reference, we found that in sexual offenders against adults and nonsexual offenders, an attempt was made to inhibit fixation on either of the presented stimuli. Likewise, a greater number of participants in the offender groups presented fixation latencies greater than 175ms: sexual offenders against children, 29%; sexual offenders against adults, 20%; nonsexual offenders, 39%; and nonoffending men, 14% (Table S12). This proportion was again significantly different across the four groups (Table S12). Using the group of nonoffending men as reference, *post-hoc* comparisons revealed that nonsexual offenders had a significantly higher proportion, and sexual offenders against children and sexual offenders against adults tended to show a higher proportion, but this was not significant after correcting for multiple comparisons. These results could mean that groups of offenders tended to inhibit their natural ocular response, in comparison with the group of nonoffending men.

Relative versus absolute fixation duration

Analyzing relative rather than absolute fixation times can be useful (e.g. Fromberger et al., 2012, 2013). However, this was not useful in our case because, if we were to calculate the proportions in the way that Fromberger et al. (2012) did, with respect to the total presentation time of the images (5000 ms in our case), there would be no changes at all in the results. Statistically, this is exactly the same as analyzing raw times, as all values are simply divided by the same number (the presentation time of the images), and differences are therefore proportionally the same. This would make sense if images were presented for varying amounts of time, but that is not our case.

Alternatively, it would be possible to look at relative fixation times to each stimulus by dividing the fixation times by the sum of all fixation times to all stimuli types; however, because most analyses are within-subjects, the results are, again, the same. It is possible to divide fixation times to each type of stimuli (i.e. men, women, boys, girls), by the sum of the fixation times to stimuli of that same gender (i.e. men + boys, or women + girls, as appropriate), consistent with our experimental design. By doing this, we would obtain the correct relative time that participants looked at adult or child stimuli of each gender. However, this creates a different set of problems: it would eliminate any main effects of both gender and Group, because the total relative time of fixation for every participant from any group to stimuli of either gender, is 1.00 (100%), so that there is no point in making any such comparisons. Furthermore, comparisons between groups, which are an essential part of our study, would be lost.

Supplementary References

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CAPÍTULO 6.DISCUSIÓN GENERAL

6.1 Principales hallazgos

Los hallazgos empíricos de esta tesis doctoral han contribuido al conocimiento general acerca de las preferencias y conductas sexuales humanas típicas y atípicas, utilizando medidas indirectas de los componentes cognitivos de la respuesta sexual y metodologías no invasivas y de bajo costo como la técnica de rastreo ocular. Los resultados permitieron evidenciar la existencia y la dirección de las diferencias en el patrón de atención visual temprano y tardío entre hombres y mujeres ginéfilos y andrófilos, con preferencias sexuales típicas y atípicas según la edad y el sexo de los estímulos. Se encontraron diferencias en los patrones de atención visual temprana y tardía según la edad de los estímulos, en hombres abusadores sexuales de niños, en comparación con otros delincuentes sexuales, no sexuales y hombres de la comunidad general. Demostrando sesgos atencionales sobre estímulos infantiles en abusadores sexuales de niños. Cumpliendo el fin último de la investigación, los resultados obtenidos han sido publicados, para conocimiento de la comunicad científica y lo han sido en revistas de alto impacto científico y prestigio internacional.

De manera global, los resultados revelan que el paradigma cognitivo de estímulos en competencia, fundamentado en el papel de los procesos atencionales en la respuesta sexual humana, utilizando la metodología de rastreo ocular, es útil como medida complementaria para la identificación de preferencias sexuales típicas, según la edad de los estímulos, en hombres y mujeres ginéfilos y andrófilos, según el sexo, en hombres ginéfilos y andrófilos, y en mujeres ginéfilas, pero no en mujeres andrófilas.

En relación con las preferencias sexuales ginéfilas y andrófilas según el sexo de los estímulos, se comprobó que la respuesta sexual de las mujeres andrófilas es inespecífica en un nivel preconsciente. Esta respuesta inespecífica se refleja en las primeras fijaciones relacionadas con procesos atencionales tempranos. Sin embargo, la hipótesis de la inespecificidad de la respuesta sexual femenina no parece ser explicada por exposición prenatal androgénica como se expuso en la literatura previa. Por lo que no fue posible concluir que las preferencias sexuales ginéfilas y andrófilas, así como la respuesta sexual inespecífica de las mujeres andrófilas, se encuentre asociada a la exposición prenatal androgénica, medida indirectamente a través de la proporción 2D:4D.

Finalmente, el paradigma de estímulos en competencia puede ser un complemento útil en la discriminación de preferencias sexuales atípicas en hombres, asociadas con conductas sexuales desviadas, como el abuso sexual infantil. No obstante, debe considerarse siempre como una herramienta complementaria teniendo en cuenta las limitaciones asociadas con la manipulación de la conducta y la deseabilidad social. De igual manera, debe discriminarse al agresor sexual infantil pedófilo, del no pedófilo, para establecer con claridad la utilidad de la técnica de rastreo ocular en la identificación de sesgos hacia estímulos sexuales atípicos como son los estímulos infantiles.

A continuación, se presenta un resumen de los principales resultados según los objetivos e hipótesis formulados en cada estudio:

Estudio 1. Diferencia en los patrones de atención visual en hombres y mujeres ginéfilos y andrófilos según edad y género del estímulo, a través de la medición de procesos de atención temprana y tardía usando la técnica de rastreo ocular.

Los procesos de atención sobre estímulos relevantes sexualmente juegan un papel relevante en las teorías de arousal sexual humano. La metodología de rastreo ocular

permite medir procesos atencionales tempranos y tardíos a través de la latencia, duración y frecuencia de fijaciones, las cuales proveen información acerca de las características de los estímulos que atraen la atención de los sujetos y aquellas que son más relevantes en la elección de pareja, por razones principalmente filogenéticas, pero en humanos influidas por el aprendizaje y la experiencia con los estímulos, por lo que son preferidas sexualmente. La evidencia muestra que la respuesta de atención temprana (latencia de fijación) y tardía (duración y cantidad de fijaciones) es específica hacia el estímulo preferido sexualmente en hombres ginéfilos. Igualmente, es especifica en procesos de atención tardía en hombres andrófilos, pero no se encuentra evidencia en procesos de atención temprana en este grupo de hombres. En mujeres andrófilas sólo dos estudios reportaron evidencia de inespecificidad de la respuesta atencional temprana, pero no de la tardía. En estudios que han examinado sólo la atención tardía la evidencia es contradictoria, algunos reportan inespecificidad de la respuesta según el sexo, evidenciado en duración de fijaciones similar hacia estímulos de ambos sexos. Mientras que otros reportan especificidad del patrón de atención tardío consistente con su orientación sexual reportada. Las mujeres ginéfilas parecen tener un patrón de atención especifico similar al de hombres ginéfilos, sin embargo, la evidencia es escasa.

En relación con el efecto del sexo de los estímulos sobre los procesos de atención temprana medidos a través del tiempo para la primera fijación, se encontró que hombres andrófilos y ginéfilos, y mujeres andrófilas mostraron un patrón de atención temprana específico hacia el sexo del estímulo preferido, encontrando tiempos más cortos para la primera fijación sobre los cuerpos de estímulos correspondientes con su orientación sexual reportada. El efecto fue significativamente más fuerte en hombres y mujeres ginéfilos, lo que denota la relevancia de la forma del cuerpo femenino en la elección de pareja. Mientras que las mujeres andrófilas mostraron un patrón de atención temprana o

preconsciente inespecífico hacia estímulos de ambos sexos, lo que apoya la hipótesis de inespecificidad de la respuesta sexual de mujeres andrófilas sólo en procesos de atención relativamente automáticos. Esto es coherente con evidencia reciente utilizando técnicas como pletismografía, pupilometría y rastreo ocular.

En relación con los procesos de atención tardía se encontró que todos los grupos de participantes, hombres y mujeres andrófilos y ginéfilos, mostraron un patrón de atención tardía específico hacia estímulos reportados como preferidos según su orientación sexual. Por lo que se evidenció una interacción entre el sexo, la edad del estímulo, el sexo y la orientación sexual del participante sobre la duración total de fijaciones, en la que todos los grupos, duraron significativamente más tiempo visualizando el cuerpo de estímulos adulto del sexo preferido. Esto significa que en procesos de atención tardía o procesos de atención controlados tanto hombres como mujeres, ginéfilos y andrófilos, muestran un patrón de respuesta específico hacia el estímulo que corresponde con su reporte de orientación sexual.

En relación con la edad de los estímulos y su efecto sobre los procesos de atención temprana se encontró un efecto principal de la edad del estímulo, en el que los cuatro grupos evaluados presentaron un patrón de atención temprana orientado hacia estímulos adultos en comparación con estímulos infantiles. Todos los grupos orientaron más rápidamente su primera mirada hacia el estímulo adulto que hacia el estímulo infantil, con un tamaño del efecto moderado a grande. Consistente con estudios previos, lo que parece atraer de forma preconsciente la atención hacia los estímulos sexualmente maduros es la forma general del cuerpo independiente del sexo u orientación sexual del observador, después de esta percepción global, se dispara una atención consciente que lleva a la exploración de áreas sexuales específicas relevantes para la reproducción, proceso atencional que ocurre de forma tardía.

En relación con desviaciones sexuales esta idea es relevante y consistente con la especulación de Freund et al (1991) de que la forma del cuerpo es un determinante clave de la respuesta sexual pedófila; por ejemplo, esto podría explicar por qué los hombres pedófilos distinguen menos entre los estímulos que representan a niños o niñas, que no son tan diferentes en la forma del cuerpo, que los hombres teleiófilos (prefieren adultos) que son más capaces de distinguir entre los estímulos que representan a los hombres o mujeres, cuya forma del cuerpo es marcadamente distinta en términos de pecho-cintura y cintura – cadera.

En relación con la edad de los estímulos y su efecto sobre los procesos de atención tardía, se encontró que hubo un efecto principal de la edad sobre la duración total de fijaciones, en la que todos los participantes dedicaron más tiempo a mirar el cuerpo de los adultos y específicamente el de su sexo preferido, en comparación con los cuerpos de niños.

Por tanto, se concluye que existe un patrón de atención temprana y tardía, que es específico según la edad del estímulo. En la que hombres y mujeres, tanto ginéfilos como andrófilos, seleccionan de forma preconsciente estímulos físicamente maduros para la reproducción independiente de su sexo. Una vez se procesa esta información de forma global, se procede a explorar de forma consciente el cuerpo del sexo preferido en busca de información relevante para la reproducción y/o la elección de pareja.

En relación con la inespecificidad de la respuesta sexual de mujeres andrófilas, se encontró evidencia consistente con hallazgos previos en Dawson y Chivers (2016) y Hewig et al. (2008) de que la especificidad de la respuesta femenina es propia de mujeres andrófilas, y no de mujeres ginéfilas. Además, esta inespecificidad sólo ocurre en procesos atencionales tempranos en donde se selecciona de forma pre-consciente la

información, pero no en procesos tardíos donde existe un procesamiento más controlado y minucioso de la información. Existen diversas hipótesis acerca de la inespecificidad de la respuesta sexual femenina, entre ellas la falta de exposición prenatal androgénica que caracterizaría a las mujeres andrófilas. De manera que, a menor exposición prenatal a la testosterona, menor probabilidad de especificidad de la respuesta sexual, lo que explicaría un patrón específico en hombres ginéfilos y andrófilos, y mujeres ginéfilas, quienes a causa desequilibrios hormonales prenatales podrían haber estado más expuestas a la testosterona durante la gestación y presentar respuestas muy similares a los hombres ginéfilos, como se logró evidenciar en nuestra investigación.

Respecto a las áreas específicas de interés sexual, en el primer experimento en el que se manipularon los estímulos según el sexo se encontró que, en relación con el tiempo para la primera fijación, el área que más rápido atrajo la atención de todos los participantes fue el rostro del estímulo sexualmente preferido. Esto ocurrió exceptuado el grupo de mujeres andrófilas, quienes no mostraron diferencias en la primera fijación hacia ningún área de interés especifica de estímulos masculinos y femeninos adultos. Esto es relevante, ya que el rostro tiene señales importantes para la elección de una potencial pareja en términos de atractivo, dominancia, salud y edad reproductiva. Estas señales podrían capturar la atención preconsciente de hombres andrófilos y ginéfilos, y mujeres ginéfilas quienes presentan respuestas específicas hacia el sexo preferido. En áreas eróticas como pecho y pelvis no se encontraron diferencias según el sexo del estímulo en ninguno de los cuatro grupos, lo que llevó a confirmar que preseleccionan la forma general del cuerpo (Seto, 2017), para posteriormente procesar claves sexuales relevantes específicas en procesos de atención más tardíos.

En el primer experimento, pero en relación con la duración de las fijaciones, se encontró que todos los participantes mostraron atención tardía significativamente mayor

hacia áreas eróticas, pecho y pelvis, y no eróticas, rostro, de su estímulo adulto preferido sexualmente. Fue interesante encontrar que la atención sobre el rostro disminuía y aumentaba sobre pecho y pelvis, cuando se observaba el estímulo preferido sexualmente coherente con la orientación sexual reportada. Sin embargo, las diferencias entre el rostro de los estímulos se mantuvieron cuando se presentaba el estímulo preferido vs el no preferido, comprobando el rol modulador del rostro en la elección de pareja.

Otro hallazgo interesante fue que especialmente los grupos de hombres y mujeres ginéfilos se fijaron significativamente más tiempo en la región de la pelvis de los estímulos de mujeres adultas, que los grupos de hombres y mujeres andrófilos, en la pelvis de hombres adultos. En estos últimos, las diferencias fueron más marcadas en la visualización del pecho de hombres adultos. Esto es relevante dado el valor reproductivo y de atractivo que representa el pecho para quienes prefieren hombres y la región cintura cadera para quienes prefieren mujeres (e.g., Coy, Green, & Price, 2014; Fan, Dai, Liu, & Wu, 2005; Tovée, Maisey, Vale, & Cornelissen, 1999).

En el segundo experimento, se comprobó que en hombres y mujeres andrófilas y ginéfilas, no son las áreas específicas del cuerpo las que atraen de forma preconsciente la atención, sino la forma general del cuerpo, ya que no se encontraron efectos de la edad sobre el tiempo para la primera fijación en ninguna área de interés especifica. Sin embargo, los hallazgos sobre la duración total de fijaciones mostraron que una vez se toma consciencia de las características del estímulo relevante sexualmente, se da un proceso de atención tardía sobre áreas específicas, eróticas y no eróticas, relevantes que denotan madurez sexual, salud reproductiva y atractivo en la elección de pareja. En este proceso independiente del sexo de los estímulos, hombres y mujeres miran significativamente durante más tiempo rostro, pecho y pelvis de los adultos, que, de los

niños, aunque la diferencia fue menos marcada en el rostro y muy clara para las áreas eróticas.

Nuevamente se confirmó en este experimento que el área erótica más atendida depende de la orientación sexual del participante. De manera que, en hombres y mujeres ginéfilos predominó la atención sobre la pelvis de los estímulos de mujeres, mientras que en hombres y mujeres andrófilos predominó la atención sobre el pecho los estímulos de hombres. Lo que parece indicar que estas áreas ofrecen información importante sobre la madurez sexual y atractivo de potenciales parejas. La pelvis, que representa la región cintura-cadera se considera indicador de salud y capacidad reproductiva, lo que sería relevante para ginéfilos. El pecho se considera indicador de fuerza física en hombres, y correlaciona con atractivo masculino, lo que sería relevante para andrófilos.

Finalmente, se encontró que, en los cuatro grupos estudiados el área menos atendida en niños fue el área pélvica, lo cual es consistente con resultados previos, en donde se encontró que personas sin intereses pedófilos pasan menos tiempo observando el área pélvica de estímulos infantiles comparado con estímulos adultos.

Estudio 2. Relación entre la proporción 2D:4D como indicador de exposición prenatal androgénica, y los procesos de atención temprana y tardía hacia estímulos sexualmente preferidos usando la técnica de rastreo ocular en hombres y mujeres ginéfilos y andrófilos:

El segundo estudio se formuló, teniendo en cuenta los hallazgos del estudio 1 (Vásquez-Amézquita et al., 2017) en los que las mujeres andrófilas mostraron un patrón de atención temprana inespecífico hacia estímulos adultos de ambos sexos, acorde con la hipótesis de inespecificidad de la respuesta sexual femenina y basados en una de las diez

hipótesis formuladas por Chivers (2017) acerca de la posible influencia de la exposición prenatal sobre la especificidad de la respuesta sexual. De manera general se confirmó que todos los participantes tendieron a mirar más rápido y más tiempo los estímulos adultos del sexo preferido, sin embargo, estos hallazgos fueron independientes de la proporción 2D:4D, la cual no mostró ninguna relación, ni con el patrón de atención temprana, ni tardía sobre el estímulo preferido sexualmente. Por ello, no se logró comprobar que exista una influencia de la exposición prenatal androgénica sobre la respuesta sexual manifiesta a través de los procesos atencionales sobre estímulos relevantes sexualmente.

En relación con las diferencias en la proporción 2D:4D entre hombres y mujeres, se logró comprobar, como se esperaba según evidencia previa, que existe una diferencia significativa según el sexo de los participantes, en la que independientemente de la orientación sexual reportada, los hombres presentaron proporciones significativamente más bajas, que las mujeres. Estos hallazgos apoyan la hipótesis organizacional-activacional de las hormonas sexuales, en la que la proporción 2D:4D de los hombres sería menor como consecuencia de una mayor exposición a la testosterona durante la gestación.

Por el contrario, en relación con la orientación sexual de los participantes, no se encontraron diferencias entre hombres y mujeres con preferencias hacia el mismo sexo y hombres y mujeres con preferencias hacia el sexo opuesto. Tampoco fue posible comprobar que hombres y mujeres ginéfilos tuvieran proporciones 2D:4D menores que hombres y mujeres andrófilos. Por lo que la proporción 2D:4D no fue suficiente para probar que exista un desequilibrio en los niveles de androgenización prenatal en hombres y mujeres con preferencias hacia el mismo sexo. Sólo en algunas etnias se ha logrado evidenciar diferencias en la proporción 2D:4D entre personas con preferencias hacia el mismo sexo en comparación con quienes tienen preferencias hacia el sexo opuesto. Lo

que sugiere que en una muestran suramericana altamente mezclada como la nuestra, podrían no manifestarse las variaciones en la proporción 2D:4D. Es posible que la relación entre la proporción 2D:4D y la orientación sexual sólo pueda ser detectada en muestras grandes y pueda verse afectada por influencias étnicas y culturales (por ejemplo, presiones locales, Kangassalo et al., 2011).

Sobre la relación entre la proporción 2D:4D y los procesos de atención temprana y tardía hacia estímulos adultos del sexo preferido, no se encontraron relaciones significativas que permitieran probar latencias cortas y duración de la atención mayor sobre estímulos preferidos sexualmente de hombres y mujeres con proporciones 2D:4D más bajas. Se esperaba que a menores proporciones 2D:4D, indicadoras de mayor exposición a la testosterona, se observará un patrón especifico de menores latencias y mayor atención sobre cuerpos, y especialmente áreas eróticas como pecho y pelvis, del estímulo preferido sexualmente. Sin embargo, no se encontró efecto de la proporción 2D:4D sobre el patrón atencional.

Aunque todos los grupos se fijaron más rápido, más tiempo y con más frecuencia sobre las áreas eróticas (pecho, pelvis) y no eróticas (cara) de sus estímulos sexualmente preferidos, y estos estímulos fueron evaluados como más atractivos y excitantes sexualmente, este efecto no aumentó en los participantes con una relación 2D: 4D más baja (más masculinizada), a pesar de que las relaciones fueron, en general, en la dirección esperada. Por lo tanto, usando un diseño novedoso y ecológicamente válido, no encontramos evidencia de la hipótesis de Chivers (2017) sobre una posible influencia neurohormonal temprana sobre la especificidad de respuesta sexual adulta.

A estos hallazgos se ofrecieron dos explicaciones plausibles y relacionadas: la relación 2D: 4D no es un marcador preciso de la exposición androgénica prenatal (Bailey et al., 2016; Hampson & Sankar, 2012), o la exposición prenatal a andrógenos tiene un

efecto débil sobre la orientación sexual y el comportamiento sexual, aunque esto entra en conflicto con la evidencia reciente (Hamann et al., 2014; Zheng & Cohn, 2011). Basados en la evidencia (Berenbaum, Bryk, Nowak, Quigley, & Moffat, 2009; Hampson & Sankar, 2012; Zheng & Cohn, 2011), concluimos que el marcador no es necesariamente poco confiable, sino que su débil efecto sugiere que no es muy preciso o útil para medir el efecto de las hormonas prenatales en la orientación sexual y los patrones de comportamiento asociados, dada su multicausalidad y el efecto de otros factores en los patrones de comportamiento típicos del sexo, como las variaciones étnicas, culturales, efecto de hormonas postnatales circulantes y socialización.

Estudio 3. Diferencias en patrones de atención temprana y tardía hacia estímulos sexualmente maduros (adultos) en competencia con estímulos sexualmente inmaduros (niños) entre cuatro grupos de hombres adultos: 1) condenados por abuso sexual contra niños; 2) condenados por agresión sexual contra adultos; 3) condenados por delitos no sexuales; 4) comunidad general sin antecedentes de delitos, utilizando la metodología de rastreo ocular.

A partir de los hallazgos en los estudios 1 y 2 (Vásquez-Amézquita et al., 2017, 2018) que permitieron evidenciar que personas con preferencias sexuales típicas, hombres y mujeres ginéfilos y andrófilos, orientan más rápido y atienden durante más tiempo a los cuerpos y áreas eróticas sexualmente relevantes de estímulos preferidos adultos en comparación con estímulos infantiles; y en especial los hombres presentan preferencias sexuales de categoría específica según sexo y edad, en el tercer estudio se puso a prueba el mismo paradigma experimental con hombres condenados por abuso sexual infantil en comparación con otros delincuentes sexuales (condenados por acceso carnal violento contra mujer adulta), delincuentes no sexuales (otros delitos no sexuales) y hombres heterosexuales de la comunidad general, con el fin de establecer diferencias

en atención temprana y tardía sobre estímulos de ambos sexos, sexualmente inmaduros (niños) en competencia con estímulos sexualmente maduros (adultos).

Los resultados respaldaron algunas de las hipótesis formuladas. En relación con la atención temprana, se tuvieron dos indicadores, el tiempo para la primera fijación y el número de primeras fijaciones. Se encontró que ni la edad ni el sexo del estímulo tuvieron efecto sobre el tiempo para la primera fijación en ninguno de los cuatro grupos, por tanto, no se pudo comprobar a través de este parámetro que exista una orientación inicial más rápida hacia estímulos infantiles en el grupo de abusadores sexuales. Sin embargo, con el segundo indicador de atención temprana, se encontró una tendencia marginalmente significativa, sólo en el grupo de abusadores sexuales de niños, a presentar un mayor número de primeras fijaciones sobre estímulos infantiles que sobre estímulos adultos, en comparación con los tres grupos de referencia, quienes evidenciaron mayor número de primeras fijaciones sobre estímulos adultos que sobre estímulos infantiles. Los resultados sugieren que el número de primeras fijaciones es un parámetro más sensible a la identificación de preferencias sexuales y menos manipulable por parte de los participantes, especialmente cuando se tiene alguna preocupación por el significado de su comportamiento ocular, como es el caso de personas condenadas por comportamientos ilegales o población general que infieren el objetivo y temen dar respuestas socialmente no aceptables.

En relación con los procesos de atención tardía, se tuvieron dos indicadores, la duración total y la cantidad de fijaciones. Tanto en la duración total de las fijaciones como en cantidad de fijaciones sobre el cuerpo entero, los abusadores sexuales de niños tendieron a fijarse más tiempo y con más frecuencia en los estímulos infantiles en comparación con los otros dos grupos de delincuentes, y fue el único grupo en el que no hubo efecto principal de la edad del estímulo, a pesar de que todos los grupos tendieron

a mirar más tiempo y más cantidad de veces los estímulos adultos en comparación con los infantiles, congruente con evidencia previa (Fromberger et al., 2013).

Con respecto a las áreas específicas del cuerpo, se encontró que la atención tardía se mantuvo por más tiempo y con mayor frecuencia en áreas eróticas (pecho y pelvis) de estímulos de mujeres adultas en los cuatro grupos, confirmando evidencia previa (Dixson, Grimshaw, Linklater, & Dixson, 2011; Fromberger, Jordan, von Herder, et al., 2012; Vásquez-Amézquita et al., 2017). Sin embargo, en el grupo de abusadores sexuales de niños, en comparación con los otros grupos de delincuentes, no se encontraron diferencias significativas entre las fijaciones hacia el pecho de mujeres y niñas, y se fijaron más y con mayor frecuencia en el pecho de niñas y niños, que los otros dos grupos delictivos, en coherencia con investigaciones recientes (Hall, Hogue, & Guo, 2015). La región del pecho puede señalar rápidamente la madurez sexual de los estímulos, por lo que estos resultados apoyan la idea de que abusadores de niños difieren de otros hombres en su respuesta hacia los estímulos infantiles (Dixson et al., 2011; Hewig et al., 2008; Jasienska, Ziomkiewicz, Ellison, Lipson, & Thune, 2004; Krupp, 2008; Seto, 2017).

6.2 Limitaciones y perspectivas futuras

En el desarrollo de esta tesis doctoral y sus hallazgos han emergido también, algunas limitaciones que dan lugar a perspectivas futuras para continuar enriqueciendo esta línea de investigación.

En relación con los parámetros de medición de los procesos atencionales tempranos, se encontró que el tiempo para la primera fijación no es suficientemente sensible a la detección de sesgos preatencionales hacia los estímulos sexuales relevantes, como lo fue el número de fijaciones, el cual se recomienda como una medida relativamente automática menos susceptible de manipulación voluntaria del sujeto,

especialmente en casos donde la conducta puede resultar inaceptable socialmente, como las preferencias sexuales hacia el mismo sexo o las desviaciones sexuales, como la pedofilia o el abuso sexual infantil. Así mismo, por criterios conceptuales sugerimos denominar a las primeras fijaciones, medidas de atención temprana y no medidas automáticas, como se ha venido tratando en la literatura, ya que, aunque ocurren de forma preconsciente no son del todo involuntarias y deben tratarse como medidas *relativamente* automáticas.

En el tercer estudio, el tiempo hasta la primera fijación, la duración total de las fijaciones la cantidad de fijaciones sobre el cuerpo entero no fueron lo suficientemente sensibles para discriminar entre los cuatro grupos; posiblemente en esto haya influido que los grupos de delincuentes estaban preocupados de que sus resultados pudieran afectarlos y comportarse de una manera socialmente deseable (Cima et al., 2003). Según Trottier, Rouleau, Renaud y Goyette (2014), una reducción significativa en la frecuencia de las fijaciones durante el proceso de evaluación reflejaría los intentos de mentir por parte del participante, y esta disminución en la frecuencia de la fijación para inhibir la respuesta sexual podría deberse a la atención encubierta del participante para distraer cognitivamente del contenido del estímulo, lo que desencadena una exploración breve del estímulo. Esto sucedió en este estudio, porque los participantes condenados difirieron en sus respuestas de los participantes no delincuentes, en la duración y el número de fijaciones, lo que sugiere que puede haber habido un deseo de mentir o manipular su respuesta de forma socialmente aceptable. Los estudios futuros podrían incluir medidas de deseabilidad social y también ofrecer otras formas de asegurar a los participantes que los datos no se relacionan con ellos de forma individual.

En relación con la selección de la muestra de participantes con preferencia sexuales típicas, los estudios tuvieron como limitación la exclusión de pedofilia utilizando

sólo cuestionarios de reporte subjetivo acerca de fantasías sexuales y/o distorsiones acerca de los niños y la sexualidad; sin embargo, el uso de estos instrumentos no garantiza que nuestros participantes no mientan al respecto, por lo que una entrevista clínica semi-estructurada conducida por un experto en parafilias sería más apropiada para descartar en los grupos de referencia intereses sexuales hacia los niños.

En esta línea, la principal limitación del tercer estudio fue no haber podido identificar a los abusadores sexuales de niños como pedófilos, dado que tal vez sólo la mitad de los abusadores sexuales de niños podrían ser pedófilos (Seto, 2008). El cuestionario de distorsiones acerca de los niños y el sexo es, en el mejor de los casos, sólo un correlato de intereses sexuales pedófilos, pero se ha demostrado que no todos los pedófilos necesariamente presentan estas distorsiones, que incluso también podrían estar presentes en la población general. Las investigaciones futuras en las que se utilice un diseño experimental similar, pero que compare abusadores sexuales de niños pedófilos y no pedófilos, aportarán significativamente en este campo de investigación.

Respecto a la versión del paradigma experimental utilizada, la visualización de imágenes se realizó libremente, y no se preguntó sobre el atractivo de las imágenes durante el experimento, para reducir la probabilidad de que los participantes pudieran inferir el objetivo del estudio. A pesar de esto, la presentación de estímulos adultos e infantiles semidesnudos pudo facilitar que los participantes infirieran el objetivo del estudio y llevar a algunos a manipular sus respuestas de forma socialmente deseables. Para reducir esta posibilidad, los estudios futuros que utilicen este paradigma podrían incluir distractores emocionales no sexuales y emocionalmente neutros, que han sido útiles en experimentos con estímulos sexuales (Nummenmaa et al., 2006) para enmascarar el objetivo del estudio e investigar preferencias sexuales atípicas (Jordan et al., 2016).

En relación con el uso del paradigma en la identificación de preferencias sexuales inespecíficas en mujeres andrófilas, los estímulos utilizados fueron no eróticos ni explícitos sexualmente, dado que una parte del objetivo de esta tesis era evaluar la utilidad del paradigma con estímulos infantiles con abusadores sexuales de niños. Sin embargo, en futuras investigaciones centradas en la inespecificidad de la respuesta sexual femenina, se sugiere el uso de estímulos con diferentes grados de intensidad sexual, dado que la investigación empírica reciente (Chivers et al., 2015; Spape, Timmers, Yoon, Ponseti, & Chivers, 2014) ha mostrado que la especificidad de la respuesta sexual femenina puede verse afectada por otros factores, entre ellos la presentación de estímulos prepotentes (genitales expuestos y excitados) y el tipo de actividad erótica (ej. sadomasoquismo).

Así mismo y para finalizar, en relación con la investigación de la inespecificidad de la respuesta sexual femenina, se sugiere incluir muestras de mujeres con diferentes grados de preferencias sexuales ginéfilas y andrófilas, medidas dentro de un continuo y no como categorías dicotómicas, ya que la inespecificidad de la respuesta sexual sólo ha podido comprobarse en mujeres exclusivamente andrófilas; mujeres con algún grado de ginefilia han mostrado respuestas sexuales específicas (S. J. Dawson & Chivers, 2016), sin embargo, estos resultados se basan en un único estudio y requieren ser replicados, ya que la mayoría de investigaciones seleccionan muestras exclusivamente andrófilas o exclusivamente ginéfilas, sin tener en cuenta otros grados dentro del continuo de las preferencias sexuales según el sexo de los estímulos.

CAPÍTULO 7. CONCLUSIONES

Los estudios empíricos desarrollados en esta tesis doctoral llevaron a las siguientes conclusiones presentadas en este capítulo:

1. La técnica de eye tracking y los paradigmas de visualización libre de estímulos son útiles en la identificación de preferencias sexuales típicas y atípicas, desviadas y no desviadas.

2. Los patrones de atención de hombres y mujeres ginéfilos con preferencias sexuales típicas y atípicas no desviadas fueron muy similares, a los patrones atencionales de hombres y mujeres andrófilos, lo que concuerda con la idea de que hombres y mujeres siguen las mismas pautas en la selección de estímulos preferidos sexualmente.

3. Hombres ginéfilos y andrófilos, y mujeres ginéfilas, presentan patrones de atención preconscientes hacia estímulos preferidos sexualmente. Esto es contrario a lo observado en mujeres andrófilas que presentan un patrón de atención preconsciente inespecífico hacia estímulos adultos preferidos y no preferidos.

4. Personas de ambos sexos, andrófilos y ginéfilos, muestran un patrón de atención visual consciente específico hacia estímulos que corresponden con sus preferencias sexuales reportadas.

5. Personas de ambos sexos e independientemente de sus preferencias sexuales ginéfilas o andrófilas presentan un patrón de atención temprano y tardío especifico hacia estímulos adultos, en comparación con estímulos infantiles.

6. Personas de ambos sexos e independientemente de sus preferencias sexuales ginéfilas o andrófilas muestran patrones atencionales tardíos hacia áreas eróticas y no eróticas

de estímulos adultos que denotan madurez para la reproducción, en comparación con áreas específicas en cuerpos infantiles.

7. La proporción 2D:4D como indicador de exposición prenatal a la testosterona, es significativamente más baja entre hombres que mujeres, independiente de su orientación sexual.

8. No existe relación entre la proporción 2D:4D y los patrones de atención visual hacia estímulos preferidos sexualmente o sus regiones específicas eróticas o no eróticas. Por tanto, no se ha podido confirmar una influencia de la testosterona prenatal sobre las preferencias sexuales.

9. Los abusadores sexuales de niños presentan una tendencia inversa en comparación con otros delincuentes sexuales, no sexuales y población general, a orientar su atención más rápido hacia estímulos infantiles en comparación con estímulos adultos.

10. Los abusadores sexuales de niños tienden a fijarse durante más tiempo y con mayor frecuencia, en el cuerpo, pero especialmente en el pecho de estímulos infantiles en comparación con otros grupos de delincuentes.

11. El uso del eye tracking y los paradigmas de visualización de estímulos en competencia serían de utilidad para probar preferencias sexuales desviadas, en grupos de abusadores sexuales de niños, con intereses sexuales pedófilos, cuyos patrones atencionales pueden diferir de abusadores sexuales de niños sin estos intereses sexuales específicos.

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