UNIVERSIDAD
DE GRANADA

Estudio del comportamiento de los agentes económicos para la provisión de bienes públicos en entornos de segregación étnica

Jesús Martín Rodríguez

Directores:

Dra. Teresa María García Muñoz

Dr. Antonio Manuel Espín Martín

Granada, 2019

Editor: Universidad de Granada. Tesis Doctorales
Autor: Jesús Martín Rodríguez
ISBN: 978-84-1306-204-4
URI: http://hdl.handle.net/10481/55751

El doctorando / The *doctoral candidate* **[Jesús Martín Rodríguez]** y los directores de la tesis / and the thesis supervisor/s: **[Teresa María García Muñoz y Antonio Manuel Espín Martín]**

Garantizamos, al firmar esta tesis doctoral, que el trabajo ha sido realizado por el doctorando bajo la dirección de los directores de la tesis y hasta donde nuestro conocimiento alcanza, en la realización del trabajo, se han respetado los derechos de otros autores a ser citados, cuando se han utilizado sus resultados o publicaciones.

/

Guarantee, by signing this doctoral thesis, that the work has been done by the doctoral candidate under the direction of the thesis supervisor/s and, as far as our knowledge reaches, in the performance of the work, the rights of other authors to be cited (when their results or publications have been used) have been respected.

Lugar y fecha / Place and date:

Granada a 26 de Febrero de 2019

Director/es de la Tesis / *Thesis supervisor/s;* Doctorando / *Doctoral candidate*:

Firma / Signed

Firma / Signed

Agradecimientos

A mi director Antonio Espín, por su incondicional apoyo y motivación, por transmitirme la importancia de la calidad investigadora, por creer en mí y sobre todo, por su gran amistad. Sin él esto no habría sido posible.

A mi directora Teresa García, por su apoyo, por su dedicación y por la confianza depositada. Muchas gracias por supervisar y dirigir.

A mis coautores, Pablo Brañas-Garza, Juan Gamella y Benedikt Herrmann por sus excelentes aportaciones.

A Joseph Henrich, Hillard Kaplan, Jonathan Schulz, Hannes Rusch, Tom Dickins, Willem Frankenhuis por sus útiles y brillantes comentarios.

A los participantes en la reunión de SEJyD 2016 y a los de los seminarios de la Middlesex University, Universidad de Granada y Universidad Loyola Andalucía por sus comentarios y sugerencias.

A todas y cada una de las personas que han participado en los estudios de esta tesis doctoral y que de una u otra manera me han ayudado, porque ellas la han hecho posible.

A mis padres, por hacerme la vida tan fácil. A mi madre por enseñarme el valor de las cosas, a mi padre, por enseñarme el camino para lograr mis objetivos y sobre todo, por ser un referente en mi vida y un espejo en el que mirarme. Gracias a vosotros, me he convertido en lo que soy.

A mi hermano José, por ser un ejemplo de hermano mayor, por soportarme a lo largo de los años, por ayudarme en los momentos difíciles y por estar siempre a mi lado.

A mis amigos, Juan, Mari, Pati, Hermida, Arroba, Alberto Wee, Sandra, Luis, Paquito, Juanico, los Ales (S., V., B.), Noni, Nacho, Alberto I., Enrique, Pablo, Montes… por quererme como soy, y por supuesto a Miguel Reinoso por enseñarme este camino.

Por último y más importante, a mi mujer Laura, por su cariño y apoyo, por entenderme cada día, por ser un pilar fundamental en mi vida y por querer estar a mi lado para siempre. Gracias por acompañarme.

Índice

Resumen

Resumen

El presente trabajo de investigación es el desarrollo de la Tesis para la obtención del grado de Doctor del Programa de Ciencias Económicas y Empresariales dentro de la línea de investigación de Economía Pública: Recaudación, salud, dependencia, educación y gestión del agua, enmarcado en la Facultad de Ciencias Económicas y Empresariales de la Universidad de Granada.

Dentro de la ciencia económica, se está produciendo un notable avance hacia la economía experimental y del comportamiento. Mediante esta metodología, se ha demostrado la existencia de pautas de comportamiento económico que eran asumidas de forma diferente, y errónea, por la teoría económica estándar. Los modelos económicos tradicionales se han basado en la asunción de que el único objetivo de los individuos es la maximización de su propio beneficio sin tener en cuenta la situación de los demás individuos. Sin embargo, los resultados basados en el método experimental han atacado estos supuestos básicos: las personas, en su gran mayoría, realmente sí tienen en cuenta la situación ajena a la hora de tomar sus decisiones.

La presente tesis tiene como objetivo principal profundizar sobre las preferencias y las dinámicas de cooperación en entornos donde existe segregación o fragmentación de tipo étnico. Además, tiene como objetivos determinar el comportamiento de los individuos de diferente etnia para la provisión de bienes públicos en entornos segregados y no segregados desde la óptica de las preferencias sociales. También, debido a la influencia de la impaciencia (o descuento temporal) como factor clave para la provisión de bienes públicos, se estudia cómo las diferentes condiciones socio-ecológicas a las que se enfrentan los miembros de diferentes grupos se traducen en diferencias de comportamiento en este sentido. Por último, comparamos el descuento temporal entre los habitantes de un extenso conjunto de países para determinar el efecto diferencial de los procesos de discriminación intergrupal, en particular los relacionados con la fragmentación étnica, sobre el descuento temporal, examinando si son articulados a través de un endurecimiento de las condiciones socio-ecológicas.

Para la consecución de los objetivos, primero se realizó una serie de experimentos donde un conjunto de individuos participaron en un juego de bienes públicos con posibilidad de castigo a fin de observar cómo el comportamiento de castigo se ve modulado por la fragmentación étnica y los procesos intergrupales. Se reclutó a "gente común" perteneciente a dos grupos étnicos: Gitanos (la minoría) y no-Gitanos (la mayoría). En segundo lugar, se estudió experimentalmente el descuento temporal de una parte de la muestra de Gitanos y no-Gitanos referenciada anteriormente. Por último, mediante un estudio empírico donde se utilizaron bases de datos representativas a nivel mundial, se comparó el descuento temporal de los individuos de los diferentes países para determinar el efecto diferencial de factores socio-ecológicos relacionados con la fragmentación étnica. Para obtener mayor robustez en los resultados, consideramos: (i) dos bases de datos de dos encuestas que miden el descuento temporal de los participantes, (ii) tres proxies sobre factores socio-ecológicos ambientales (esperanza de vida, tasa de mortalidad infantil y PIB per cápita), y (iii) cuatro diferentes medidas acerca de la fragmentación étnica de un país como son la fraccionalización, la segregación espacial, la polarización, y la desigualdad (en términos de bienestar material).

Los resultados sugieren que las personas de etnia Gitana, que tiene una organización social fuertemente basada en el parentesco y la identidad étnica, no usan el mecanismo de sanción hacia otros Gitanos no cooperativos, excepto cuando en el grupo hay tanto Gitanos como no-Gitanos y, por tanto, su fuerte identidad étnica se ve amenazada por tales comportamientos no cooperativos. Sin embargo, los no-Gitanos también enfocaban sus decisiones de castigo más sobre Gitanos que sobre otros no-Gitanos en esos grupos. Estos resultados apoyan una perspectiva de selección de grupos culturales en cuanto a la evolución del comportamiento de castigo "altruista", aunque también parecen criticar algunas de sus predicciones.

En cuanto a las preferencias temporales, los resultados demostraron que los Gitanos muestran tasas de descuento más altas que los no-Gitanos, aún controlando por el estatus socio-económico actual de los individuos. Dado que los Gitanos se enfrentan a condiciones socio-ecológicas más duras (por ejemplo, menor esperanza de vida, mayor mortalidad infantil, menor acceso a recursos materiales, acompañado de una larga historia de persecución y discriminación), estos resultados apoyan los modelos basados en las Teorías evolutivas de Historia de Vida según los cuales descontar fuertemente el futuro

puede ser adaptativo en entornos socio-ecológicos duros. Se conjetura que los procesos de discriminación intergrupal devienen en entornos socio-ecológicos duros a los que los individuos responden priorizando el presente. Finalmente, en el último estudio examinamos la validez de tal argumento usando una medida de discriminación intergrupal a nivel de país. Los resultados están en línea con esta hipótesis, a la que añadimos la fragmentación étnica (especialmente la segregación espacial de los grupos étnicos), como precursora de los procesos de discriminación intergrupal y, en última instancia, del aumento en el descuento temporal de los individuos como adaptación al entorno de relativa dureza promovido por la discriminación.

Capítulo 1: Introducción

1 Introducción

Los modelos económicos tradicionales se han basado en la premisa de que el único objetivo de los individuos es la maximización de su propio interés sin tener en cuenta la situación de los demás individuos (Levitt & List 2008, Thaler 2000, Henrich et al. 2001). En estos modelos, las preferencias de los agentes económicos están orientadas a sus propios resultados, preocupándose por las interacciones sociales solo en la medida en que afecten a su consumo final y su riqueza. El día a día confirma el hecho de que el comportamiento de los seres humanos a menudo no se amolda a estos supuestos. Por ejemplo, las personas pueden ser vengativas y/o caritativas, se preocupan por la justicia, sancionan a otras personas cuando trasgreden las normas sociales o contribuyen a los bienes comunes.

Desde las teorías clásicas de elección racional (Von Neumann & Morgenstern 1944), así como desde una perspectiva evolutiva (Maynard Smith 1982), estas conductas no egoístas son difíciles de explicar. ¿Qué mueve a las personas para beneficiar o perjudicar a otras personas, a menudo en contra de su propio interés?

Tales conductas pueden explicarse de forma racional, por ejemplo, si se llevan a cabo sobre individuos relacionados genéticamente o hay posibilidad de labrarse una reputación, es decir, siempre que estos comportamientos reviertan en el propio beneficio material o reproductivo en el futuro (Gintis 2000, Nowak 2006, Axelrod & Hamilton 1981, Trivers 1971, Hamilton 1964). Pero los seres humanos muestran comportamientos no egoístas también en entornos no repetidos (sin efectos de reputación) y con individuos totalmente desconocidos, donde no existe posibilidad de beneficio futuro, y es aquí donde las teorías tradicionales encuentran dificultades a la hora de buscar una explicación. Uno de los ejemplos más estudiados gira en torno a la provisión de bienes públicos, definidos como aquellos bienes no rivales y no excluibles de los que se benefician tanto las personas que contribuyen a los mismos (es decir, cooperan) como las que no. La teoría tradicional predice que nadie cooperará en estas situaciones dado que es más beneficioso aprovecharse de los bienes públicos provistos por otros. La decisión de si contribuir o no al bien público es lo que se considera un dilema social, porque contrapone los intereses individuales a los colectivos. Esta lógica se aplica por ejemplo a la participación

democrática, el reciclaje, la guerra, las interacciones comerciales, la conducción de vehículos, la lucha contra el cambio climático y el pago de impuestos (Gintis et al 2003, Henrich 2015).

Una gran parte de los avances científicos en esta línea se han producido gracias al método experimental, mediante el cual se ha demostrado la existencia de conductas no egoístas en entornos controlados de laboratorio usando paradigmas como el juego de bienes públicos, el dilema del prisionero o el juego del ultimátum (Ledyard 1995, Güth et. al 1982, Fehr & Gächter 2002). En estos experimentos, incluso cuando se trata de juegos no repetidos y bajo estricto anonimato, a menudo se observa que los participantes sacrifican recursos materiales (los juegos se llevan a cabo usando incentivos monetarios reales proporcionados por el investigador) para tomar decisiones que benefician a otros o que refuerzan normas sociales como la justicia (Camerer 2003).

Dentro de la ciencia económica, de hecho, se está produciendo un notable avance en los últimos años hacia este método científico basado en la observación de patrones de comportamiento en entornos controlados experimentalmente. Aunque la experimentación es central para la investigación en otras ciencias como la física o la biología desde tiempos inmemoriales, la *Economía Experimental y del Comportamiento* -que así se denomina esta rama de la economía- se ha afianzado en los últimos años en la primera línea de investigación en nuestra ciencia (Brañas-Garza 2011, Guala 2005, Kagel & Roth 1995). Este éxito se debe a las ventajas que proporciona el método experimental: control de las variables y replicabilidad de las investigaciones[1].

Esta tesis pretende arrojar luz sobre los elementos que determinan la provisión de bienes públicos utilizando metodologías de la Economía Experimental y del Comportamiento. La evidencia empírica señala que la provisión de bienes públicos, y por ende la prosperidad económica, se ve afectada negativamente por la fragmentación étnica. En entornos fragmentados étnicamente, las sociedades encuentran dificultades para proveer bienes públicos a la población y desarrollar instituciones que alienten el

[1] La economía experimental aplica métodos de laboratorio para el estudio de los seres humanos en contextos sociales donde, para la realización de estos experimentos económicos, se tiene que tener en cuenta el entorno, el comportamiento y las instituciones. En los contextos sociales donde se aplican los métodos de laboratorio, existen secuencias controladas por el experimentador e información sobre los eventos de los juegos entre personas (reglas explícitas) pero también existen hábitos, normas y tradiciones que los individuos traen consigo al laboratorio como parte de su herencia evolutiva cultural y biológica y que normalmente no son controladas por el experimentador (reglas implícitas) (Smith, 1994).

desarrollo económico (Easterly & Levine 1997, Alesina et al. 1999; ver Alesina & La Ferrara 2005 para una revisión de la literatura).

Uno de los obstáculos para la provisión de bienes públicos viene dado por el hecho de que las personas son "grupalistas", es decir, tienden a favorecer al propio grupo y/o perjudicar a otros grupos (Tajfel 1974, Brewer 1999, Dovidio et al. 2008). En entornos de fragmentación étnica es muy probable que los procesos de discriminación intergrupal se vean agravados y esta sea una de las principales causas para la insuficiente provisión de bienes públicos. En esta tesis se aborda esta hipótesis desde dos pilares fundamentales: el impacto de los procesos intergrupales sobre el comportamiento social y las preferenciales por el corto versus el largo plazo. No en vano, en las decisiones sobre la provisión de bienes públicos, a menudo, intervienen factores interpersonales e intertemporales. Dicho de otro forma, las decisiones de los individuos suelen conllevar externalidades sobre otras personas y/o sobre el futuro (un ejemplo muy claro es la lucha contra el cambio climático, donde las decisiones de unos agentes, léase países, tienen efectos sobre el bienestar presente y futuro de todos los agentes implicados). La contribución al bien público en general acarrea un coste individual a corto plazo y unos beneficios a largo plazo para otras personas, por lo que tanto las preferencias sociales como las temporales de los individuos son factores clave: para contribuir al bien público es muy probable que se requiera una preferencia por mejorar la situación de los demás y una orientación al largo plazo. Dentro del comportamiento social, nos centraremos en las decisiones de castigo entre individuos como mecanismo para reforzar la norma de la cooperación.

Una de las contribuciones principales de este trabajo de investigación radica en la aplicación de una perspectiva evolucionista al comportamiento humano. En contra de la tradición en las ciencias sociales, las teorías evolucionistas típicas de la psicología evolutiva (como las Teorías de Historia de Vida) a menudo se fundamentan en el impacto del entorno socio-ecológico sobre el comportamiento. De esta forma, las preferencias de los individuos se determinan adaptativamente en respuesta al contexto de forma endógena, en lugar de ser exógenas, como suele suceder en los modelos económicos. Gurven (2018), de hecho, llama recientemente la atención sobre la bondad de este tipo de análisis y argumenta que serán esenciales para el futuro de las ciencias conductuales. En suma, se pretende arrojar luz sobre cómo el entorno socio-ecológico que rodea a las

personas, y en particular la incidencia de los procesos intergrupales, modula su comportamiento social y sus preferencias temporales.

1.1 Comportamiento social: cooperación y refuerzo de normas sociales

La cooperación entre seres humanos, que a menudo se da entre individuos anónimos no relacionados genéticamente, es considerada un rompecabezas por las ramas más diversas de la ciencia. Desde la biología y la antropología hasta la economía y la neurociencia se han afanado por entender el fenómeno de la cooperación desde hace décadas (Richerson et al 2016, Henrich 2004, Axelrod & Hamilton 1981, De Quervain et al. 2004). Dado que cooperar es entendido como ayudar a otros incurriendo en un coste propio, un dilema social emerge. Las teorías de selección natural, por su parte, resultan inadecuadas para explicar la evolución de un comportamiento que mejora al grupo a un coste para el individuo. Tanto la selección por parentesco (Hamilton 1964), como la reciprocidad en su forma directa (te ayudo si tú me ayudas) o indirecta (te ayudo si tú ayudas a otros) han dado forma a variadas y buenas respuestas al dilema de la cooperación (Nowak 2006, Trivers 1971, Axelrod & Hamilton 1981). Sin embargo, cuando se trata de cooperar con desconocidos en encuentros esporádicos estos argumentos sufren ciertas carencias fundamentales.

El castigo denominado "altruista" (la forma negativa de la llamada "reciprocidad fuerte": cooperar con quien coopera y castigar a quien no lo hace; Fehr & Gächter 2002, Gintis et al. 2003) ha sido propuesto en los últimos años como un factor esencial para que los encuentros no repetidos desemboquen en cooperación. La amenaza de ser castigados por no cooperar, lo que conlleva un coste, promueve que los individuos lo hagan. Además, el que castiga debe también incurrir en un coste para que tal amenaza sea creíble (Fehr & Gächter 2002).

Como ejemplo, imaginemos un grupo de desconocidos que han de empujar un vehículo que se ha estropeado en plena calle y no deja pasar a sus propios vehículos. Suponiendo que el coste físico de empujar uno mismo el vehículo sea mayor que el beneficio obtenido por retirarlo del camino, todos los miembros del grupo tienen incentivos individuales a no desgastarse empujando y aprovechar al máximo el empuje de los demás. El resultado obvio, de generalizarse tal comportamiento, sería que el

vehículo no se movería por no ejercerse la fuerza suficiente. Esto es, precisamente, lo que predicen las teorías de la racionalidad basada en la maximización del puro interés personal. Sin embargo, el miedo a que alguien del grupo te repruebe por no empujar el vehículo puede inclinarte a hacerlo.

Pero, eso sí, una acción de este tipo no es gratuita y entraña sus propios costes, como hemos dicho. El coste para quien recibe la reprimenda puede emanar, por ejemplo, de la vergüenza de ser reprobado en público. El precio que debe pagar el que castiga puede provenir a su vez, por ejemplo, de una posible respuesta violenta del castigado. Y aquí es donde el castigo pierde peso explicativo como impulsor de la cooperación ya que se genera un dilema social de segundo orden (Yamagishi 1986): ¿quién va a incurrir en un coste para castigar a quien no coopera y mejorar así la situación del grupo? Ejemplos como el anterior cobran vida a diario en el trabajo y el deporte en equipo, en la cola del supermercado y en un sinfín de situaciones cotidianas más. Efectivamente, todos sabemos que quien no coopera o no respeta una norma social a menudo es castigado de una forma u otra. La explicación científica de este comportamiento tan común no es, no obstante, ni mucho menos trivial. Las teorías clásicas se han mostrado inadecuadas para darle solución a este dilema de segundo orden y han caracterizado el comportamiento de castigo como irracional, a nivel proximal, y maladaptativo, a nivel último (evolutivo) (Cosmides & Tooby 1992, Johnson et al. 2003).

Recientemente han surgido teorías basadas en la selección (cultural) grupal (CGS por sus siglas en inglés) que abren nuevas vías para la interpretación de los comportamientos de cooperación y castigo (Richerson et al 2016, Henrich 2004). Si se establecen dos niveles de selección, uno individual y otro grupal, el dilema parece tener solución. En efecto, los individuos pueden identificarse con el grupo y percibir que lo mejor para todos es cooperar e, incluso, castigar a quien no lo hace. De esta forma, llegaría a generarse un *"trade-off"* entre defender la propia posición dentro del grupo y defender la posición del grupo. Los grupos con normas culturales más cooperativas saldrían ganando en el proceso de competición intergrupal, por lo que este tipo de normas se verían favorecidas por la selección al ser adaptativas a nivel grupal. La identificación y los procesos intergrupales son, de esta forma, esenciales en las teorías de CGS.

En el Capitulo 2, se presenta un estudio experimental en el que mis coautores y yo testamos el poder predictivo de las teorías de selección de grupos culturales, en

contraposición a las teorías del "Gran Error" (BM por sus siglas en inglés), basadas en la selección individual, para explicar el comportamiento de castigo. En concreto, realizamos experimentos de cooperación multilateral con posibilidad de castigo entre individuos utilizando una muestra de participantes pertenecientes a la población romaní española (etnia Gitana), por mostrar unas características únicas para nuestro objetivo. En comparación con la población mayoritaria que les rodea, los Gitanos tienen una organización social más fuertemente basada en el parentesco y la cercanía, además de presentar una identidad étnica mucho más marcada. Las dos primeras características están en el centro de las teorías de BM, mientras que la identidad de grupo es un factor clave para las teorías de CGS.

Según las teorías de BM (Cosmides & Tooby 1992, Johnson et al. 2003, Lehmann et al. 2007, Delton et al. 2011), los comportamientos prosociales, como el castigo altruista, evolucionaron en tiempos ancestrales cuando prácticamente todas las interacciones tenían lugar entre personas cercanas y/o relacionadas genéticamente. Así, los mecanismos que subyacen a la evolución del castigo altruista serían los típicos de la selección individual, esto es, la reciprocidad y la selección por parentesco. Dicho de otra forma, el castigo altruista, siguiendo estas teorías, evolucionó en ese entorno porque castigar a otros miembros del grupo mejoraba el éxito reproductivo del castigador, otorgándole beneficios a sí mismo y/o a sus descendientes (por ejemplo, a través de reducir el riesgo de ser explotado por otras personas en el futuro).

Este proceso habría generado una psicología social panhumana que el humano moderno, que interactúa mucho más con extraños y en encuentros esporádicos, aplica "por error" en situaciones donde es maladaptativo (es decir, donde ya no beneficia, sino que perjudica, el éxito reproductivo individual).

Un total de 320 adultos, entre Gitanos y no-Gitanos, asistieron voluntariamente a participar en 10 sesiones experimentales (32 sujetos por sesión) realizadas en sus municipios de residencia, situados en el norte de la provincia de Granada (zona de alta concentración de población de etnia Gitana). Los asistentes participaron en un juego no repetido de bienes públicos con castigo (PGP por sus siglas en inglés) en grupos étnicamente *homogéneos* (todos Gitanos o todos no-Gitanos) o *mixtos* (mitad Gitanos, mitad no-Gitanos) de 4 personas anónimas.

El PGP es una extensión multilateral del "dilema del prisionero". En nuestro caso particular, siguiendo metodología estándar (Gächter & Herrmann 2009), cuatro jugadores anónimos cooperaban mediante la contribución de una parte de su dinero inicial (10€) a un fondo común. La suma de las contribuciones al fondo se multiplicaba por dos y se dividía equitativamente entre los cuatro miembros del grupo. De esta forma, cada jugador recibía 0.50€ de cada unidad monetaria que hubiera dentro del fondo, independientemente de cuál fuera su contribución personal al mismo. Esto significa que contribuir 1€ acarreaba un coste de 0.50€, lo que incentivaba a aprovecharse de la cooperación de los demás. De esta forma, si todos los miembros del grupo cooperaban al máximo (contribuían los 10€) se maximizaba la eficiencia/beneficio social (20€ para cada miembro). Sin embargo, el beneficio individual se maximiza no cooperando (contribuyendo 0€) y aprovechando la cooperación de los demás. Los participantes decidían si cooperar o no simultáneamente, sabiendo ex-ante de la existencia de una etapa posterior en la cual los miembros del grupo podían reducir las ganancias de los otros miembros a un coste personal (etapa de castigo), todo bajo condiciones de estricto anonimato. En esa segunda etapa los participantes eran informados de la cooperación de cada uno de los miembros del grupo, identificados por colores, y decidían cuánto reducir las ganancias de los demás. Para reducir 3€ las ganancias de otro miembro del grupo – esto es, castigarle – un participante debía pagar 1€.

El sistema de identificación por colores se llevó a cabo para que en los grupos *mixtos* los participantes pudieran asociar a los otros miembros del grupo con sus respectivas etnias. Es decir, se le hizo notar a los participantes (de forma sutil) que dos de los cuatro colores representaban a Gitanos y los otros dos a no-Gitanos para que así pudieran condicionar sus decisiones de castigo a la etnia de la otra persona.

Bajo la hipótesis de BM, en los grupos *homogéneos*, los Gitanos deberían castigar de manera similar (por ser humanos "modernos" con una psicología social panhumana) o un poco más (por estar más relacionados genéticamente y basar más sus interacciones en la cercanía) que los no-Gitanos. Por otro lado, bajo la hipótesis que sostienen los teóricos de CGS de que el castigo altruista es particularmente importante para la cooperación entre los no familiares en las sociedades a gran escala, la predicción sería que los no-Gitanos deben castigar más que los Gitanos. Nuestros resultados claramente

apoyan esta última predicción. De hecho, en grupos *homogéneos* los Gitanos prácticamente no hacían uso del mecanismo de castigo.

Con respecto a los grupos *mixtos*, las predicciones de las dos teorías difieren sobre todo en el hecho de que, según CGS, la mera presencia de miembros de otras etnias refuerza la identificación con la propia etnia y consecuentemente la discriminación intergrupal en la toma de decisiones, mientras que para BM tal presencia no debe influir sobre las decisiones que se toman para con los miembros de la propia etnia. Es decir, CGS predice que los participantes castigarán más a los miembros no cooperativos de su propia etnia en los grupos *mixtos* que en los *homogéneos*, para defender la identidad de su grupo que se ve amenazada. Sin embargo, las teorías de BM predicen comportamientos de castigo hacia los miembros de la propia etnia similares en las dos condiciones experimentales, pues los procesos intergrupales se consideran básicamente irrelevantes a nivel evolutivo.

Nuestros resultados vuelven a desacreditar las predicciones de BM pero, sin embargo, tampoco apoyan completamente las de CGS. Si bien, tanto Gitanos como non-Gitanos, castigan a los de su propia etnia de forma diferente en grupos *mixtos* que en *homogéneos*, la predicción de CGS solo se cumple entre los Gitanos. Esto es, mientras los Gitanos castigaron sobre todo a los miembros no cooperativos de su propia etnia en los grupos *mixtos* (cosa que no sucedía en grupos *homogéneos*), los no-Gitanos castigaron sobre todo a los de la otra etnia. En resumen, los participantes de etnia Gitana que no cooperaban en los grupos *mixtos* recibían las reprimendas tanto de Gitanos como de non-Gitanos. Como posibles desencadenantes de estas divergencias con respecto a las predicciones teóricas, discutimos el estatus de mayoría *versus* minoría de los diferentes grupos étnicos, así como la identidad étnica más marcada que muestran los Gitanos (también influida por su estatus de grupo minoritario). También observamos diferencias de género llamativas en cuanto a comportamiento de cooperación y castigo.

1.2 Preferencias temporales

Al igual que el resto de especies, los seres humanos están constantemente tomando decisiones que implican un intercambio entre beneficios (o pérdidas) presentes y futuros. El sacrificio de una recompensa presente por una recompensa mayor en el futuro es a

menudo un aspecto fundamental de tales decisiones. Este intercambio intertemporal puede determinar cómo se resuelven, por ejemplo, dilemas como el existente entre el ahorro y el consumo, entre la inversión en formación y el ocio, o entre conductas cooperativas y egoístas o incluso agresivas (Becker & Mulligan 1997, Espín et al. 2017, Meier & Sprenger 2012).

Las decisiones intertemporales se caracterizan por una disminución en el valor subjetivo de las recompensas a medida que se retrasa el momento de recibirlas (Ainslie, 1975). La impaciencia o descuento temporal (TD por sus siglas en ingles[2]), consecuencia de lo anterior, se define como la preferencia de los individuos por recompensas más cercanas en el tiempo en lugar de recompensas más grandes pero que se recibirán más tarde.

Los estudios experimentales que miden el TD de los participantes han arrojado mucha luz sobre las bases de la (im)paciencia (Harrison et al. 2002, McClure et al. 2004), siendo la amplia heterogeneidad entre individuos uno de los resultados más establecidos (Frederick et al. 2002). Estos resultados sugieren que las personas difieren mucho unas de otras en la forma en que toman sus decisiones sobre el futuro, habiendo individuos más impacientes que prefieren recompensas más cercanas en el tiempo y otros más pacientes que tienden a retrasarlas más.

Sin embargo, los orígenes de tales diferencias individuales son todavía desconocidos en gran medida. Es decir, aún queda mucho por descubrir acerca de las causas que influyen sobre el hecho de que unos individuos sean más pacientes que otros. Cierta evidencia apunta que el TD puede tener una base hereditaria (Anohkin et al. 2011), mientras otros trabajos señalan que factores como el estatus socio-económico pueden influir en su desarrollo o en la forma en que se manifiesta (Tanaka et al. 2010). No obstante, estos factores parecen representar solo una pequeña parte de las diferencias individuales en TD.

La perspectiva adaptacionista de las Teorías de Historia de Vida ofrece una base para el entendimiento del TD, en tanto que se argumenta que los individuos descuentan el futuro porque las condiciones socio-ecológicas del ambiente indican que existe

[2] A menudo se denomina como descuento de retardo (DD por sus siglas en inglés). Esta terminología se usa por ejemplo en el capítulo 3.

posibilidad de no resistir hasta recibir las recompensas futuras (Pepper & Nettle 2017, Frankenhuis et al. 2016). Las estrategias de historia vida se desarrollan como adaptación al contexto a fin de maximizar el éxito reproductivo del individuo y dan lugar a una serie de lo que se denominan rasgos de historia de vida. Los modelos más influyentes basados en estas teorías describen las estrategias de vida, en cuanto a la asignación de recursos de los organismos a diferentes funciones vitales (reproducción, manutención, cuidado de hijos, etc.), dentro de un continuo "de rápido a lento" (Kaplan & Gangestad 2005).

De esta forma, los entornos más duros e impredecibles generan estrategias de vida rápidas (con rasgos como una elevada y temprana fecundidad) que detraen recursos futuros en favor de objetivos presentes, mientras que los entornos más seguros y predecibles conllevan el desarrollo de estrategias lentas, es decir, al otro lado del continuo (con rasgos como una reducida y tardía fecundidad). De acuerdo con estos argumentos, descontar fuertemente el futuro, lejos de representar un comportamiento maladaptativo, puede ser una respuesta contextualmente apropiada en entornos duros y/o impredecibles. La existencia de diferencias en las condiciones socio-ecológicas a las que se enfrentan los individuos durante las etapas del desarrollo en las que se establece el DT, según este marco teórico, es un determinante crucial de la existencia de diferencias individuales en DT (Griskevicius et al. 2011, Brumbach et al. 2009).

En el capítulo 3 testamos la predicción de estos modelos de que los individuos que se desarrollan bajo condiciones socio-ecológicas más duras e impredecibles deben descontar el futuro en mayor medida. Para ello, aprovechamos una parte de la muestra referida en el capítulo 2, a la cual medimos su TD con metodología estándar (Perales et al. 2009, Harrison et al. 2002, Espín et al. 2012). En efecto, la población Gitana muestra elementos relacionados con las estrategias de vida rápidas en comparación con la mayoría. Por ejemplo, la población de etnia Gitana se enfrenta a unas tasas de mortalidad y fertilidad mayores y a una esperanza de vida menor, así como a un estatus socio-económico más bajo (Gamella 2011, MSC-FSG 2005). Además, los Gitanos, como otros grupos romaníes, han sufrido una larga historia de discriminación y persecución que marca fuertemente su idiosincrasia como grupo etnocultural.

Nuestros resultados apoyan claramente las predicciones de las Teorías de Historia de Vida. En comparación con la mayoría, los participantes de etnia Gitana eligieron más veces la opción impaciente en una tarea de TD que consistía en 20 decisiones entre recibir

150€ un mes después del experimento (opción impaciente) y una cantidad mayor (creciente desde 151.5€ hasta 225€) siete meses después del experimento. Este resultado se cumple incluso controlando por el estatus socio-económico actual de los participantes, que también tiene cierta influencia sobre el TD.

Como explicación a esos resultados, sugerimos que los procesos de discriminación intergrupal incrementan el DT de los individuos, en particular de los grupos más afectados por la discriminación, a través de un endurecimiento de las condiciones socio-ecológicas a las que se enfrentan. De esta forma, los procesos de discriminación intergrupal tendrían un efecto sobre el comportamiento de los individuos no contemplado hasta ahora en la literatura, articulado a través de un endurecimiento de las condiciones socio-ecológicas al que los individuos responden priorizando el corto plazo. Las implicaciones de esto serían de gran importancia dado que el conflicto y la discriminación intergrupal son inherentes al ser humano (Tajfel et al. 1979, Sober & Wilson 2011).

Sin embargo, una de las limitaciones del capítulo 3 es que, al incluir sólo dos grupos étnicos, no se puede analizar cómo afecta cada uno de los factores que diferencian a las dos etnias al desarrollo del TD de sus miembros. En consecuencia, se realiza un tercer estudio desarrollado en el capítulo 4 donde analizamos la relación existente a nivel agregado entre la incidencia de los procesos de discriminación intergrupal y el TD. Más concretamente, testamos la validez de este argumento por medio de modelos de ecuaciones estructurales a nivel de país usando datos conductuales de DT recientes (Bulley & Pepper 2017, Falk et al. 2018), una medida proxy para la incidencia de la discriminación intergrupal (Group Grievance Index; FSI 2018) y tres proxies para la dureza de las condiciones socio-ecológicas (esperanza de vida, tasa de mortalidad infantil y PIB per cápita). Elegimos estas tres últimas variables porque recogen una gran parte de la información ambiental que, según las Teorías de Historia de Vida, es crucial para el desarrollo de las estrategias vitales (del Giudice et al. 2015).

Ahondando en las causas de los procesos de discriminación intergrupal, también comprobamos el impacto de una serie de variables que miden diferentes elementos de la

fragmentación/segregación étnica de un país, como son los índices de fraccionalización, segregación espacial[3], polarización y desigualdad.

Usando cualquiera de las tres medidas de dureza ambiental, encontramos una fuerte relación negativa entre la proxy de discriminación intergrupal a nivel país y la paciencia de sus habitantes que está parcialmente mediada por las condiciones de dureza ambiental del país. Este resultado, por tanto, apoya nuestra hipótesis de partida.

En cuanto al efecto de la fragmentación étnica como precursora de la discriminación intergrupal, los resultados no son tan concluyentes y varían en función de la base de datos de DT que se use. Las medidas de segregación espacial y quizá de fraccionalización parecen ajustarse un poco mejor a las predicciones que las medidas de desigualdad y, sobre todo, de polarización étnica.

En definitiva, nuestros resultados sugieren que los procesos de discriminación intergrupal modifican el descuento temporal de los individuos a través de un endurecimiento del entorno, al cual responden adaptativamente priorizando el corto plazo. Además, establecemos la fragmentación como una razón potencial que subyace a los procesos de discriminación intergrupal en un país determinado y, en última instancia, al DT de sus habitantes. Más concretamente, parece que una mayor separación geográfica entre los diferentes grupos étnicos (es decir, la medida de segregación espacial) dentro de un país es el factor de fragmentación étnica evaluado que más se relaciona tanto con la incidencia de los procesos de discriminación intergrupal como con las preferencias temporales de los individuos.

[3] Nótese que para no confundir la segregación en términos generales (entendida como cualquier tipo de diferencia o separación entre etnias) con la segregación de tipo espacial o geográfica, en el capítulo 4, utilizamos “fragmentación” para el primer caso y “segregación” para el segundo.

Referencias

Ainslie, G. (1975). Specious reward: A behavioral theory of impulsiveness and impulse control. *Psychological Bulletin*, 82(4), 463.

Alesina, A., Baqir, R., & Easterly, W. (1999). Public goods and ethnic divisions. *The Quarterly Journal of Economics*, *114*(4), 1243-1284.

Alesina, A., & Ferrara, E. L. (2005). Ethnic diversity and economic performance. *Journal of economic literature*, *43*(3), 762-800.

Anokhin, A. P., Golosheykin, S., Grant, J. D., & Heath, A. C. (2011). Heritability of delay discounting in adolescence: a longitudinal twin study. *Behavior genetics*, 41(2), 175-183.

Axelrod, R., & Hamilton, W. D. (1981). The evolution of cooperation. *Science*, 211(4489), 1390-1396.

Becker, G. S., & Mulligan, C. B. (1997). The endogenous determination of time preference. *The Quarterly Journal of Economics*, 112(3), 729–758.

Brañas-Garza, P. (2011). *Economía experimental y del comportamiento*. Antoni Bosch editor.

Brewer, M. B. (1999). The psychology of prejudice: Ingroup love and outgroup hate?. *Journal of social issues*, *55*(3), 429-444.

Brumbach, B. H., Figueredo, A. J., & Ellis, B. J. (2009). Effects of harsh and unpredictable environments in adolescence on development of life history strategies. *Human Nature*, 20(1), 25–51.

Bulley, A., & Pepper, G. V. (2017). Cross-country relationships between life expectancy, intertemporal choice and age at first birth. *Evolution and Human Behavior*, *38*(5), 652-658.

Camerer, C. F. (2003). *Behavioral game theory: Experiments in strategic interaction*. Princeton University Press.

Cosmides, L., & Tooby, J. (1992). Cognitive adaptations for social exchange. *The Adapted Mind*, 163-228.

Delton, A. W., Krasnow, M. M., Cosmides, L., & Tooby, J. (2011). Evolution of direct reciprocity under uncertainty can explain human generosity in one-shot encounters. *Proceedings of the National Academy of Sciences*, *108*(32), 13335-13340.

del Giudice, M., Gangestad, S. W., & Kaplan, H. S. (2015). Life history theory and evolutionary psychology. *The handbook of evolutionary psychology. Vol. 1. Foundations*, 88-114.

De Quervain, D. J., Fischbacher, U., Treyer, V., & Schellhammer, M. (2004). The neural basis of altruistic punishment. *Science*, *305*(5688), 1254.

Dovidio, J. F., Gaertner, S. L., & Saguy, T. (2008). Another view of "we": Majority and minority group perspectives on a common ingroup identity. *European Review of Social Psychology*, *18*(1), 296-330.

Easterly, W., & Levine, R. (1997). Africa's growth tragedy: policies and ethnic divisions. *The quarterly journal of economics*, *112*(4), 1203-1250.

Espín, A., Sánchez, A., & Herrmann, B. (2017). Economic preferences 2.0: Connecting competition, cooperation and inter-temporal preferences. *CEDEX Discussion Papers, No. 2017-04*.

Espín, A. M., Brañas-Garza, P., Herrmann, B., & Gamella, J. F. (2012). Patient and impatient punishers of free-riders. *Proceedings of the Royal Society of London B: Biological Sciences*, rspb20122043.

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., & Sunde, U. (2018). Global evidence on economic preferences. *The Quarterly Journal of Economics*, *133*(4), 1645-1692., https://doi.org/10.1093/qje/qjy013.

Fehr, E., & Gächter, S. (2002). Altruistic punishment in humans. *Nature*, *415*(6868), 137.

Frankenhuis, W. E., Panchanathan, K., & Nettle, D. (2016). Cognition in harsh and unpredictable environments. *Current Opinion in Psychology*, 7, 76–80.

Frederick, S., Loewenstein, G., & O'donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of economic literature*, *40*(2), 351-401.

FSI. (2018). Fragile state index. http://fsi.fundforpeace.org/. Accessed Jul 2018.

Gächter, S., & Herrmann, B. (2009). Reciprocity, culture and human cooperation: previous insights and a new cross-cultural experiment. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *364*(1518), 791-806.

Gamella, J. F. (2011). Historias de éxito. Modelos para reducir el abandono escolar de la adolescencia gitana. Madrid: Ministerio de Educación, Gobierno de España.

Gintis, H. (2000). Beyond Homo economicus: evidence from experimental economics. *Ecological economics*, *35*(3), 311-322

Gintis, H., Bowles, S., Boyd, R., & Fehr, E. (2003). Explaining altruistic behavior in humans. *Evolution and Human Behavior*, *24*(3), 153-172.

Gurven, M. D. (2018). Broadening horizons: Sample diversity and socioecological theory are essential to the future of psychological science. *Proceedings of the National Academy of Sciences*, *115*(45), 11420-11427.

Griskevicius, V., Tybur, J. M., Delton, A. W., & Robertson, T. E. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: A life history theory approach. *Journal of Personality and Social Psychology*, 100(6), 1015.

Guala, F. (2005). *The methodology of experimental economics*. Cambridge University Press.

Güth, W., Schmittberger, R., & Schwarze, B. (1982). An experimental analysis of ultimatum bargaining. *Journal of Economic Behavior & Organization*, *3*(4), 367-388.

Hamilton, W. D. (1964). The genetical evolution of social behaviour. *Journal of Theoretical Biology*, *7*, 1-52.

Harrison, G. W., Lau, M. I., & Williams, M. B. (2002). Estimating individual discount rates in Denmark: A field experiment. *The American Economic Review*, 92(5), 1606–1617.

Henrich, J., Boyd, R., Bowles, S., Camerer, C., Fehr, E., Gintis, H., & McElreath, R. (2001). In search of homo economicus: behavioral experiments in 15 small-scale societies. *American Economic Review*, *91*(2), 73-78.

Henrich, J. (2004). Cultural group selection, coevolutionary processes and large-scale cooperation. *Journal of Economic Behavior & Organization*, *53*(1), 3-35.

Henrich, J. (2015). The secret of our success: How culture is driving human evolution, domesticating our species, and making us smarter. *Princeton University Press*.

Johnson, D. D., Stopka, P., & Knights, S. (2003). Sociology (communication arising): The puzzle of human cooperation. *Nature*, *421*(6926), 911-912.

Kagel, John H., and Alvin E. Roth, ed., 1995. The Handbook of Experimental Economics, *Princeton University Press.*

Kaplan, H. S., & Gangestad, S. W. (2005). Life history theory and evolutionary psychology. *The Handbook of Evolutionary Psychology*, *68–95.*

Ledyard, J. (1995). Public Goods: A Survey of Experimental Research. In J. Kagel and A. Roth, eds., *Handbook of Experimental Economics*. Princeton: Princeton University Press.

Lehmann, L., Rousset, F., Roze, D., & Keller, L. (2007). Strong reciprocity or strong ferocity? A population genetic view of the evolution of altruistic punishment. *The American Naturalist*, *170*(1), 21-36.

Levitt, S. D., & List, J. A. (2008). Homo economicus evolves. *Science*, *319*(5865), 909-910.

Maynard Smith, J. (1982). *Evolution and the Theory of Games*. Cambridge: Cambridge University Press.

McClure, S. M., Laibson, D. I., Loewenstein, G., & Cohen, J. D. (2004). Separate neural systems value immediate and delayed monetary rewards. *Science*, *306*(5695), 503-507.

Meier, S., & Sprenger, C. D. (2012). Time discounting predicts creditworthiness. *Psychological Science*, *23*(1), 56-58.

Ministerio de Sanidad y Consumo - Fundación Secretariado Gitano (2005). Health and the Roma community. Madrid: Ministerio de Sanidad y Consumo, Gobierno de España. https://www.msssi.gob.es/fr/profesionales/saludPublica/prevPromocion/promocion/desigualdadSalud/docs/Health_and_the_Roma_Community.pdf,

Nowak, M. A. (2006). Five rules for the evolution of cooperation. *Science*, *314*(5805), 1560-1563.

Pepper, G. V., & Nettle, D. (2017). The behavioural constellation of deprivation: Causes and consequences. *Behavioral and Brain Sciences*, 40, E314.

Perales, J. C., Verdejo-García, A., Moya, M., Lozano, Ó., & Pérez-García, M. (2009). Bright and dark sides of impulsivity: performance of women with high and low trait impulsivity on neuropsychological tasks. *Journal of Clinical and Experimental Neuropsychology*, *31*(8), 927-944.

Richerson, P., Baldini, R., Bell, A., Demps, K., Frost, K., Hillis, V., ... & Ross, C. (2016). Cultural group selection plays an essential role in explaining human cooperation: A sketch of the evidence. *Behavioral and Brain Sciences*, 1-71.

Smith, V. L. (*1994).* Economics in the Laboratory. *Journal of Economic Perspectives*, 8, 1 (Winter).

Sober, E., & Wilson, D. S. (2011). Adaptation and natural selection revisited. *Journal of evolutionary biology*, *24*(2), 462-468.

Tajfel, H. (1974). Social identity and intergroup behaviour. *Social Science Information/sur les Sciences Socials*, *13*(2), 65-93.

Tajfel, H., Turner, J. C., Austin, W.G., & Worchel, S. (1979). An integrative theory of intergroup conflict. *Organizational identity: A reader*, 56-65.

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and time preferences: Linking experimental and household survey data from Vietnam. *American Economic Review*, *100*(1), 557-71.

Thaler, R. H. (2000). From homo economicus to homo sapiens. *Journal of economic perspectives*, *14*(1), 133-141.

Trivers, R. L. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology*, 46(1), 35-57.

Von Neumann, J., & Morgenstern, O. (1944). *Theory of games and economic behavior*. Princeton University Press.

Yamagishi, T. (1986). The provision of a sanctioning system as a public good. *Journal of Personality and Social Psychology*, *51*(1), 110.

Capítulo 2: Bringing together "old" and "new" ways of solving social dilemmas? The case of Spanish *Gitanos*

2 Bringing together "old" and "new" ways of solving social dilemmas? The case of Spanish *Gitanos*

Abstract

Humans often punish non-cooperators in one-shot interactions among genetically-distant individuals. So-called altruistic punishment poses an evolutionary puzzle because it enforces a cooperation norm that benefits the whole group, but it is costly for the punisher. Under the "big mistake" (or "mismatch") hypothesis, social behaviors such as punishment evolved by individual selection at a time when repeated interactions with kin prevailed, and then misfired in modern humans, who "mistakenly" apply it in sporadic interactions with unrelated individuals. Cultural group selection theories, on the other hand, emphasize cultural differences in normative behavior and the role of intergroup competition and punishment for the emergence of large-scale cooperation in the absence of genetic relatedness. We conducted a series of multilateral-cooperation economic experiments with a sample of Spanish Romani people (*Gitanos*), who represent a unique cultural group to test the predictions of the two accounts: *Gitano* communities rely heavily on close kin-based networks, maintain high consanguinity rates and display a particularly strong sense of ethnic identity. A total of 320 *Gitano* and non-*Gitano* (i.e., the majority Spanish population) participants played a one-shot public goods game with punishment in either ethnically *homogeneous* or ethnically *mixed* (half *Gitano* and half non-*Gitano*) four-person groups. In *homogeneous* groups, punishment was commonly used by non-*Gitanos* but virtually inexistent among *Gitanos*. In *mixed* groups, however, *Gitanos* who did not cooperate were severely punished by other *Gitanos*, but also by non-*Gitanos* (in both cases, particularly, males). The results are more consistent with cultural group selection while also qualifying some of its predictions.

2.1 Introduction

Humans possess an extraordinary capacity for large-scale cooperation and this stands as a theoretical puzzle across the biological and behavioral sciences. Mechanisms such as kin selection, and direct and indirect reciprocity have been proposed as explanations for the evolution of cooperation in relatively small populations (Nowak 2006, Axelrod & Hamilton 1981, Trivers 1971, Hamilton 1964). To explain prosocial behavior in large modern societies, however, kinship or reciprocity mechanisms seem to be insufficient because cooperation is observed in ephemeral encounters among unrelated individuals, for instance, in voting, driving, paying taxes, recycling, market interactions and warfare (Boyd & Richerson 1988, Gintis et al. 2003). Decentralized (peer) punishment of free-riders has emerged as a crucial element for understanding the emergence of cooperation beyond kinship and small-scale groups (Sigmund 2007, Henrich & Boyd 2001, Henrich 2004, Boyd et al. 2003, Gintis et al. 2003). So-called altruistic punishment is a kind of costly norm enforcement which cannot be explained by reputation or other traditional forms of reciprocity. Punishment is considered altruistic (in the biological sense) when the absolute benefits triggered by the enforcement of the cooperative norm are received by individuals other than the punisher (Fehr & Gächter 2002).

Even if groups in which peer punishment is allowed can outcompete those in which it is not due to the discouragement of free-riding (Gächter et al. 2008, Sääksvuori et al. 2011; but see Herrmann et al. 2008), altruistic punishers are condemned to a lower evolutionary success within their group (Dreber et al. 2008, Oliver 1980). It turns out that the provision of a sanctioning system to prevent free-riding can be considered as a second-order social dilemma where individual and collective interests are in conflict (Yamagishi 1986, Fehr & Gächter 2002). Nevertheless, altruistic punishment is frequently observed in controlled experiments with unrelated human subjects, even in one-shot anonymous interactions (Fehr & Gächter 2002, Gächter & Herrmann 2009, Espín et al. 2012, Henrich et al. 2008). In fact, the neurobiological evidence suggests that people suffer disutility from observing uncooperative behaviors (Tabibnia et al. 2008, Tabibnia & Lieberman 2007, Crockett et al. 2013) and derive pleasure from punishing wrongdoers (Crockett et al. 2013, de Quervain et al. 2004, Hu et al. 2015), which facilitates punishment decisions, even if they are costly. Yet the evolutionary basis of punishment behavior and its

psychological underpinnings is subject to debate. Why do people pay irrecoverable costs to punish others?

The *"big mistake" (or "mismatch")* hypothesis (Lehmann et al. 2007, Burnham & Johnson 2005, Hagen & Hammerstein 2006, Delton et al. 2011, Krasnow et al. 2012, Tooby & Cosmides 1990, Cosmides & Tooby 1992, Johnson et al. 2003, Lamba & Mace 2011) holds that the psychological mechanisms underlying group-beneficial behaviors such as altruistic punishment evolved in a period of human history in which nearly all social interactions were repeated and took place among close relatives. Thus, "traditional" reciprocity and/or kin selection mechanisms would lie behind the evolution of punishment, which emerged because under those circumstances punishing others benefits the individual's (direct or indirect) inclusive fitness, for instance, by reducing future exploitation by others. Such pan-human social psychology, so the argument goes, misfires in the behavior of modern humans, who "mistakenly" use altruistic punishment even in one-shot interactions with unrelated individuals (i.e., where it is no longer adaptive or fitness enhancing). It is argued therefore that human social psychology is not programmed to differentiate between acquaintances and strangers, at least, beyond the desire to cultivate and maintain individually profitable, coalitional social-exchange relationships. Different ecologies or environmental cues, however, would lead to different expressions of the common evolved psychology and thus create behavioral variation.

On the other hand, following *cultural group selection* theories (Henrich & Boyd 2001, Henrich 2004, Boyd et al. 2003, Fehr et al. 2002, Fehr & Gintis 2007, Gintis et al. 2003, Soltis et al. 1995, Bowles 2006, Richerson et al. 2016, Mesoudi 2016, Richerson & Boyd 2008, Henrich 2015, Chudek & Henrich 2011), those proximate mechanisms (i.e., the negative emotions associated to the observation of uncooperative acts and the positive emotions associated to their punishment) may be particularly suited for solving the second-order dilemma of punishment—and hence the first-order dilemma of cooperation—in modern large-scale societies where one-shot interactions with non-relatives are common. Altruistic punishment would thus have been shaped following a complex process in which genes and culture co-evolve, with cultural adaptation being much more rapid than genetic adaptation. Under this account, different cultural groups develop differently the human "norm-psychology" (Chudek & Henrich 2011) in the race for survival against other cultural groups. In particular, specific social behaviors which

are advantageous for the group during intergroup competition are transmitted across individuals through social learning mechanisms (i.e., payoff- or frequency-biased imitation). Behavioral variation would not be the result of current ecology alone, as implied by the "mismatch" hypothesis, but of its interaction with cultural history as well. Therefore, it is likely that some cultural groups use decentralized punishment of free-riding extensively while others are more lenient or, most probably, use it to enforce different norms. Intergroup encounters and associated group identity cues, to the extent that they elicit differential behavioral patterns, play a fundamental role in the predictions of cultural group selection models. Not in vain, the selection of prosocial behaviors by cultural evolution hinges upon their ability to benefit the cultural group in the process of intergroup competition. Thus, under this account, human social psychology is essentially programmed to differentiate between acquaintances and strangers and, more specifically, between ingroup and outgroup individuals, as this distinction is key to the success of one's own cultural group.

To test the predictive power of these two accounts of altruistic punishment, we conducted a series of lab-in-the-field economic experiments with a unique sample of Spanish Romani people (*Gitanos*, also referred to as *Calé*). *Gitanos* constitute a paradigmatic case study for the purposes of this paper because: (i) kinship is at the core of their social life and organization even if they live a "modern" life, which in many other aspects resembles that of their non-*Gitano* neighbors (i.e., the majority Spanish population). Indeed, consanguinity rates within *Gitano* communities in the geographic area of the study are among the highest ever reported in Europe, at the upper bound of the range observed in traditional small-scale societies of hunter-gatherers and horticulturalists which are considered to resemble the living conditions of ancestral humans (see next subsection). (ii) *Gitanos* display a strong sense of ethnic identity—although in many ways share a bicultural identity (Hong et al. 2000; Benet-Martínez et al. 2002). While they mostly speak the majorities' languages and have adopted the religion and even a number of mores of their neighbors, they also maintain a strong and vibrant sense of themselves as a separate people. *Gitanos* try to preserve a separate ethnic identity often reinventing their processes of differentiation, which are mainly based on reproductive strategies where specific factors including marriage, gender and kin systems are crucial (Gamella & Martín 2007, Martín & Gamella 2005, Gay Blasco 1999, Cantón 2010). As a consequence, for example, even though *Gitanos* and non-*Gitanos* have

cohabited the study area for more than 15 generations, mixed marriages have been traditionally rare (less than 5% for over two centuries in the study area). Although this is changing in some areas where the integration of *Gitanos* in education and labor has been marked, in the localities studied, however, cross-ethnic marriages remain still under the 10% mark according to our data.

Gitanos, as other Romani groups, have developed a series of autonomous law-making processes that are often encoded in open-ended codes of norms, the *Gitano* Law. These processes have not developed into the elaborated "court" and trial systems found in Romani groups in Eastern Europe (Weyrauch 2001, Marushiakova & Popov 2007, Sorescu-Marinković 2013) but are nevertheless important in the effort to limit the escalation of conflicts between families and descent networks, where the duty of defense and support of family members is a central concern (San Román 2010). See next subsection for more details.

We conducted our experiments with a total of 320 participants (mean age = 42.80 ±18.42 SD, 59% females). Participants played a one-shot public goods game with peer punishment (PGP) involving real monetary stakes in anonymous four-person groups. We recruited *Gitano* and non-*Gitano* "ordinary people" from five small semi-rural towns with high concentration of *Gitano* population in southern Spain. The experimental design comprises two between-subjects conditions: participants played the PGP in either (i) *homogeneous* groups, composed of either only *Gitanos* or only non-*Gitanos*, or (ii) *mixed* groups, with two *Gitano* and two non-*Gitano* members. Importantly, the two conditions were run in different sessions. Thus, ethnic identity was made particularly salient in *mixed* sessions because in *homogenous* sessions there were only members of one's own cultural group. Ethnicity itself is indeed rather meaningless until the presence of "others" makes it relevant for social interaction and cultural identification processes (Tajfel 1974, Tajfel & Turner 1979, Brewer 1999, Dovidio et al. 2008). However, among minority status groups, such as *Gitanos*, group identity is often carried to every public environment (Pinel 1999). Thus it might be argued that, even in *homogenous* sessions, there was a concrete ecology of minority experience of *Gitanos* that must be considered. But in the *mixed* condition the behavior of the two cultural groups could be directly compared by the participants and this should enhance the salience of intergroup encounter cues and, therefore, of ethnic identity.

Following standard procedures (e.g., Gächter & Herrmann 2009), in the PGP participants first had to cooperate by means of (anonymously) allocating money from their €10 endowment to a group pot. Contributions were doubled and evenly shared among the four group members. Thus, the more one contributes to the group pot (i.e., the public good), the larger the total group benefit but the lower the decision maker's personal benefit, all else equal. This creates the classical social dilemma between collective and individual interests. After all participants had made their decisions, they could see the contributions of each of the other three group members and were allowed to spend part of their earnings in order to reduce others' earnings (punishment stage): €1 spent in punishment reduced the target individual's earnings by €3. Note that participants contributed knowing beforehand that they could be punished, which introduces strategic incentives to cooperate in order to avoid punishment.

Finally, by means of a subtle procedure which preserved participants' anonymity, we allowed participants in *mixed* groups to identify the ethnicity of each of the other three group members at the time of learning about their contributions, so that they could condition their punishment decisions on the target's ethnic identity—in *homogenous* groups this was trivial since all four members were of the same cultural group. See Methods for a more detailed description of the experimental procedures.

The two evolutionary accounts we aim to test make clearly different predictions about our participants' punishment behavior (see Table 1 and Figure 1 for schematic and visual representations of the predictions, respectively):

- If the "big mistake" (BM) hypothesis is correct, in *homogenous* groups, *Gitanos* should use altruistic punishment of free-riders to a similar extent as non-*Gitanos* because both can be considered as "modern" humans whose current punishment behavior represents the misfiring of a pan-human psychology (that emerged in a common ancestral past where kinship- and closeness-based interactions prevailed). If anything, one should expect misfiring to be more prominent among *Gitanos*. In other words, if punishment evolved because it yields direct or indirect inclusive fitness benefits to the punisher, *Gitanos* might in general punish wrongdoers more frequently than non-*Gitanos* due to their higher genetic relatedness and closer daily-life relationships. Moreover, the presence of members of the other cultural group

in *mixed* groups should not dramatically influence behavior except for a possible reduction in aggregate punishment (especially by *Gitanos*) compared to *homogeneous* groups along with the associated reduction of cues of genetic relatedness and the diminished likelihood of establishing coalitional social-exchange relationships among the interactants. Intergroup processes are considered to be evolutionarily irrelevant for the emergence of group-beneficial behaviors. Therefore, although the punishment of ingroups might be slightly higher than that of outgroups, the target's ethnic identity should be essentially disregarded by participants when punishing in *mixed* groups to the extent that potential coalition partners can be both targets and observers of one's own behavior and, consequently, it is the group composition that is relevant to build a reputation of "formidability" (Sell et al. 2009). The level of punishment of ingroups in the *homogeneous* and *mixed* groups should, in any case, be identical.

- On the other hand, following cultural group selection (CGS) theories, one may expect sharp differences between the two cultural groups in the homogenous condition. In homogeneous groups, altruistic punishment is expected to be used more often by non-*Gitanos*, who interact more frequently with non-relatives and in a larger scale than *Gitanos*. In mixed groups, however, the salience of ingroup-outgroup identity cues should lead participants to impose harsher punishment onto ingroup vs. outgroup wrongdoers in order to preserve group cohesiveness and, in parallel, to punish outgroup cooperators more spitefully/antisocially (Brañas-Garza et al. 2014, Herrmann et al. 2008) as harming the outgroup helps one's own cultural group outcompete other groups. Moreover, altruistic punishment of ingroup free-riders should be stronger in mixed than in homogeneous groups due to the priming of ethnic identity, whereas antisocial punishment of ingroup cooperators should be avoided in mixed groups and therefore should be stronger in homogeneous than mixed groups. The latter patterns would be expected to be more pronounced among *Gitanos*, who share a much more marked ethnic identity than the majority, and

particularly males, as they gain leadership in intergroup encounters (Mathew & Boyd 2011, Van Vugt et al. 2007, McDonald et al. 2012).

Table 1. *Basic predictions of the "big mistake" and cultural group selection hypotheses about altruistic (and antisocial) punishment behavior in the experiment.*

Hypothesis	**Homogeneous groups**	**Mixed groups**	**Homogeneous vs. Mixed**
Big mistake - mismatch	$I_G \geq I_{NG}$	$I \geq O$	$I_H = I_M$
Cultural group selection	$I_G < I_{NG}$	$I > O$ --- $I < O$ (*anti*)	$I_H < I_M$ --- $I_H > I_M$ (*anti*)

Notes: I=punishment targeted at Ingroups. O=punishment targeted at Outgroups. Subscripts G, NG, H, and M refer to Gitano punishers, Non-Gitano punishers, Homogeneous groups, and Mixed groups, respectively.

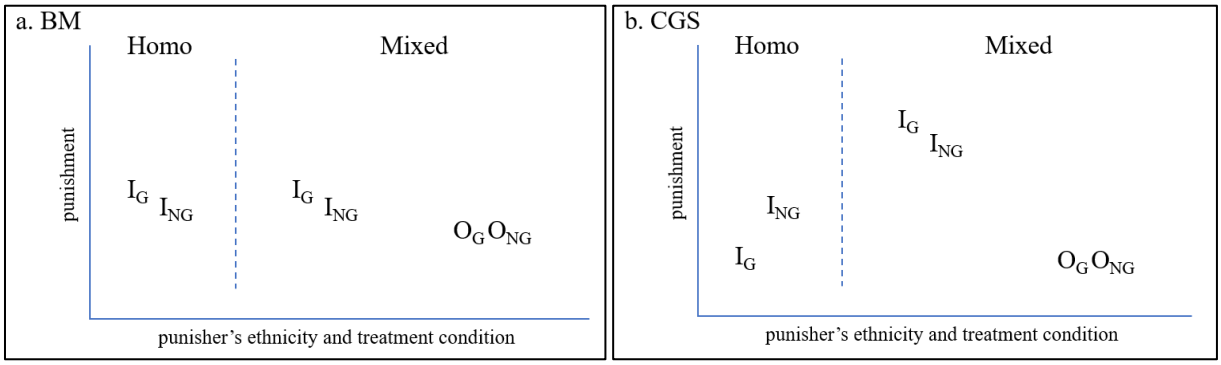


Figure 1. *Visual representation of the predictions of the "big mistake" (BM, panel a) and cultural group selection (CGS, panel b) hypotheses. I=punishment targeted at Ingroups. O=punishment targeted at Outgroups. Subscripts G and NG refer to Gitano and Non-Gitano punishers, respectively. Note that we do not plot the case of antisocial punishment because the BM hypothesis only entails predictions on altruistic punishment.*

We further test the norm-psychology account inherent to cultural group selection models by enumerating some secondary hypotheses linked to the differential cultural norms of *Gitanos* and non-*Gitanos* in the study area. This account states that human social psychology distinguishes in the animal kingdom primarily because the human mind differentially evolved a suite of cognitive adaptations for dealing with social norms defined as "learned behavioral standards shared and enforced by a community" (Chudek & Henrich 2011, p. 218). If the norm-psychology hypothesis is correct, *Gitanos*' and non-*Gitanos*' behavior in the experiment should reflect such differences in cultural norms, which work as proximate-level behavioral explanations. The next subsection explores some of those cultural differences.

2.2 A short overview on Spanish *Gitanos* and further hypotheses

The *Gitanos* or *Calé*[4] are an ethnic minority who lives today in all Spanish regions. They are somehow related to other Romani groups in Europe and America with whom they share a remote origin in India (Fraser 1992). All these groups, however, have adapted to the surrounding groups with whom they have lived and show today some traits of familial resemblance and considerable cultural heterogeneity. Even those who preserve articulated dialects of Romani language are bilingual, and thus bicultural (Matras 2015, Piasere 2004, Fraser 1992). The *Gitanos* come from the first Romani migrations into western Europe, which ended in the second half of the 15th century (Pym 2007, Leblon 1985). Their lifeways are product of a long coexistence and exchange with local Spanish populations. Life in common has been marked by persecution, segregation and discrimination, but also by cooperation and hybridization (Pym 2007, Gómez Alfaro 1998, 1999, Leblon 1985, Gamella 2011, Gamella et al. 2014).

In this sense, *Gitanos* of Spain are often portrayed as an example of successful integration. Arguably, their treatment and living conditions are relatively favorable compared to large Romani populations living in other European societies, particularly

[4] Most Spanish Romani people call themselves *Gitanos* both in private and public settings. Minority leaders also use the term to name public institutions, such as the "*Instituto de Cultura Gitana*". The first Romani groups reaching Spain in the fifteenth century were called "*Egyptanos*", as they were considered to originate in Egypt. *Gitano* is thus synonymous with the English term "Gypsy". Many Romani leaders and intellectuals reject this exonym as derogatory and prefer to be identified by their own denominations, such as Roma, Sinti, Kalé, etc. In Spain, *Gitanos* also refer to themselves as *Calé* (plural of *Caló*, black in Romani), but less frequently.

those of Central and Eastern Europe. (For instance, George Soros, the business magnate and Roma advocate and philanthropist "called upon Spain to lead Europe in bettering the conditions of the Roma" [Peiró 2012: ix]. Similar claims have been expressed often in the international mass media.) But the rosy view of the lot of the Spanish Romani is often exaggerated and downplays the discrimination and exclusion many of them still suffer in labor, income, education and even daily life encounters (Álvarez-Roldán et al. 2018). It is true, however, that since 1977, when the new political context brought about democracy and decentralization of the Spanish state, there have been clear improvements in their access to health care, education and housing, but not without conflicts and rejection by local majorities.

Today most *Gitanos* are proud of their ethnic identity, although they consider themselves autochthonous Spaniards especially in face of the large number of foreign economic immigrants who moved into Spain in the last two decades and increased ethnic and cultural diversity. *Gitanos* speak the languages and dialects of the regions where they live and have lost most of their old trades and occupations. They have, however, developed other differences to construct and vindicate their shared identity (Gay Blasco 1999, Cantón 2010, Gamella et al. 2013, 2014a, 2014b). *Gitanos'* identity often shows elements of an "oppositional identity" built in opposition or contrast to the dominant majority culture and associated with the status of involuntary minority (Ogbu & Simons 1998). But *Gitanos* have contributed much to Spanish culture and folklore. Perhaps in no other part of Europe has such a cultural fusion occurred as in Spain, especially in Andalusia, where many of the symbols and practices that identify the region to the world (such as Flamenco singing and dancing) have a crucial *Gitano* component (Leblon 1995, Pasqualino 1998).

Almost all Spanish *Gitanos* are sedentary; they have been living in the same towns and counties for generations and often have a strong attachment to their places of birth or residence, defining themselves as Andalusians, Catalans, or even *Sevillanos* and *Granadinos*. Informed estimates of the size of the *Gitano* population put it in the range of 500,000 to 600,000, around 1.5% of the total Spanish population (FSG 2008). Although in some locations, mainly in the southern region of Andalusia, where about 40% of the Spanish *Gitanos* live (even though Andalusia has less than 20% of the total Spanish population), *Gitanos* represent a particularly high fraction of the population. We

conducted our study in an area of eastern Andalusia. This geographical area was chosen due to its high concentration of *Gitanos*, thus allowing the recruitment of a sufficient number of them for our study. In the five towns hosting the experiments, *Gitanos* weight about 25.6% of the population on average (range: 20.0%-41.4%), that is, about 3,970 over a total of 15,490 inhabitants, according to our estimates for 2007.

Some *Gitano* cultural traits are essential for the understanding of their social behavior, and of punishment in particular. These are mainly associated with social organization and gender roles. We summarize their differential characteristics in the following lines and develop further hypotheses about how some of these cultural traits might translate, as proximate-level explanations, into observed behavior in the experiment.

Social organization and "the family"

Even considering the growing heterogeneity of *Gitanos*, largely their social universe is based on kinship and marriage relations. Their main social networks are family networks, and these tend to be larger, denser, more complex and multifunctional than those of their non-*Gitano* neighbors (or *Payos*, as *Gitanos* often refer to them).

For *Gitanos* today, their most important institution is "the family". The *Gitano* particular notion of family encompasses many different meanings (e.g., *la familia, mi familia, los míos, los de mi sangre*: the family, my family, my folks, of my own blood), which can be summarized across two levels (Gay Blasco 1999, San Román 2010, Gamella 2000, Martín & Gamella 2005, Gamella & Martín 2007). First, compared to non-*Gitanos*, *Gitanos* display a relative smaller stress in the household or co-resident domestic unit and a more general understanding of the "closest family" as including a network of households formed by close kinship links. Considering the different moments in the developmental cycle of domestic units we would find, for instance, that a specific couple with their children would gravitate heavily and almost daily towards the parents of either the husband or, more rarely, of the wife, depending of their residence arrangements and their possible consanguineous ties. Second, there are a larger number of people included in any kin network due to several processes that differ from the majority at large: in particular, (i) higher fertility leading to a larger number of siblings and, in turn, aunts-uncles, cousins, second cousins, etc.; (ii) higher consanguinity in marriage that generates

a multiplicity of links between members of any network, as well as higher network homogeneity.

Inbreeding has indeed been strikingly common among *Gitanos*, who show a marked preference to marry "known", compatible and "good" people from reliable interrelated kin networks. This is not only stemming from geographic isolation or inheritance rules and patrimonial strategies. It is more the result of social isolation or segregation, but also of a marked cultural preference for endogamy (Gamella 2019).

It has long been argued that in premodern or "traditional" societies kinship "provides […] an organizing medium of trust relations. Kin people can usually be relied upon to meet a range of obligations more or less regardless of whether they feel personally sympathetic towards the specific individuals involved" (Giddens 1990, p. 101), while in modern societies relationships of trust have been replaced by "friendship, sexual intimacy as a means of stabilizing social ties" (p. 102). The dominant idea is that modernity implies isolation from kin networks and individuals confront each other as separate entities "divorced from their kinship and family units" (Finkler et al. 2001, p. 236). This is variable across countries, however. Precisely, Spain as well as other southern European countries are usually portrayed as "familial" societies, where family bonds and support are relatively prominent, and individualism is somehow limited by family obligations (Reher 1998). Therefore, the distinction between *Gitanos* and Spaniards at large in this regard might be considered as a question of degree rather than as an absolute one. But the density and intensity of kin bonds often generate a differential institutional setup and affect the interpretative lens shared by local *Gitanos*.

Inbreeding is much more common among *Gitanos* than among Spaniards at large and has shown both a distinctive character and evolution. Even if Spain maintained some of the highest levels of inbreeding in Europe, they began to fall in the 1950s and, in following decades, the fall was so rapid that consanguineous marriages have become as rare as in other Western countries (Fuster & Colantonio 2002, 2004, Calderon et al. 2009). Within *Gitano* communities, however, inbreeding has been and remains widespread. According to our data for the period 1875-2005, in the area where this study was conducted, about half (49.4%) of all *Gitano* marriages are among relatives, with close-kin consanguineous marriages ranging between 24% and 27% and averaging 26.5%. A conservative estimation yields average inbreeding coefficients (Wright's F) of about 10.4

($x10^{-3}$), levels never found in Spain and much less so recently. In the same area, aggregate consanguinity rates (including *Gitanos* and non-*Gitanos*) have indeed never surpassed 7%, and average F coefficients have moved in the range of 2-2.5 ($x10^{-3}$) (Núñez Negrillo 2015). Note that recent comparable estimates for small-scale societies of hunter-gatherer and horticulturalists report average F values well below 2 ($x10^{-3}$) and 10 ($x10^{-3}$), respectively (Walker 2014, Walker & Bailey 2014). Given the strong correlation between coefficients of inbreeding and mean relatedness (Hamilton's r) of groups (Walker 2014), these data demonstrate that Romani people of this area are highly genetically related on average, even compared with people from small-scale societies. Multiple consanguinity is the norm among *Gitanos*: couples are linked by several bonds and share many ancestors, a product of a pattern of inbreeding sustained through generations. Although these patterns are starting to change and the rate of marriages between *Gitanos* and non-*Gitanos* is increasing slowly, they have been quite constant in the last decades.

In sum, even in a region where consanguineous marriages had been important, inbreeding among *Gitanos* shows particularly high intensity and permanence, being the product of a strong cultural preference and not only of geographical isolation and poverty. Hence, it is somehow reasonable that *Gitanos* spread that sense of kin to the whole community: "here we all are family"; "all *Gitanos* are related, they share some blood, at least a drop of blood for sure"; "distant but relatives". Neighbors, friends and partners are often family as well.

The enforcement of norms – a norm-psychology hypothesis

Regarding norm-enforcement institutions, other Romani groups have formal conflict resolution processes and tribunals. *Gitano* people, however, use more informal systems of justice and adjudication of rights to avoid the escalation of violence and blood feuds (San Román 1986, 2010). Respected elders, typically men (*hombres de razón* or *hombres de respeto*: "men of reason" or "men of respect"), are often asked to mediate. Affinal kin relationships may also limit the extent and seriousness of conflicts, which have been recurrent and feared. Still today a serious conflict (a death) may imply the abandonment of their residences by several hundreds of the closest kin of the accused.

Notwithstanding this, *Gitanos*, particularly males, display a comparatively strong sense of individual autonomy (Piasere 2012, Matras 2015, San Román 2010, Gay Blasco

1999, Álvarez-Roldán et al. 2018) which, added to the possibility of escalation of conflict between families, may restrict the role of decentralized overt sanctioning unless key norms are transgressed. This culture of liberty or resistance, possibly related with the avoidance of conflict between *Gitano* families, should be associated with a low willingness to punish in *homogeneous* groups if cultural differences are translated into game play as predicted by a norm-psychology account. This proximate-level prediction is indeed in line with the basic prediction of the cultural group selection hypothesis, which was stated above using an evolutionary perspective. An earlier study with a sample of Spanish *Gitanos* provides preliminary support for this prediction. Brañas-Garza et al. (2006) used ultimatum game experiments to examine sharing and punishment behavior in anonymous one-shot bilateral interactions between *Gitanos* in Vallecas, Madrid. Most of them did not express any willingness to punish stingy co-ethnics (but see Espín et al. 2012, 2015, for combined evidence suggesting that the psychology underlying the rejection of low offers in the ultimatum game may differ from that underlying altruistic punishment in the PGP). Furthermore, a common rationale of *Gitanos* who were unwilling to reject unfair, even zero, offers was, "what if (s)he needs the money?". This suggests that sporadic acts of uncooperativeness carried out by *Gitanos* may not per se be considered by other *Gitanos* as deserving peer punishment.

Gender roles – a norm-psychology hypothesis

In general, *Gitanos* are portrayed as a group that sustains relatively conservative or patriarchal gender relationships, where women are subordinated to fathers and brothers when they are single, and to their husbands and husband's family when married (San Román 2010, Gay Blasco 1999). Care of children, family members and the sick are generally seen as women's primordial tasks, but in this regard there is only a degree of difference with non-*Gitanos* of this area.

It is rarely considered, however, the considerable agency developed by *Gitano* women in their daily lives, both in the domestic and public realms. It is often *Gitano* women who confront authorities in administrative matters, and in the defense of their rights to housing, education or public benefits. But they do that somehow as in delegation by their husbands and partners; it is part of their accepted gender roles. In confrontational encounters judged as impersonal, *Gitano* women could be very assertive, and their attitudes are often seen as inadequate by majority standards, as if they were not following

the same patterns of modesty and good manners of middle-class Spaniards. This supposed lack of accomodation to their subordinate status is part of the generalized anti-*Gitano* bias, that reflects important majority norms, a process also found in respect to anti-Roma bias in Eastern Europe (Kende et al. 2017).

But in personal interactions, or in front of *Gitano* people, the presence of males in public encounters somehow transforms the ways most *Gitano* women will voice their concerns and pursue their interests (J.F. Gamella, personal communication). There exists a number of principles that *Gitano* women must typically follow in these cases: e.g., "never let him to lose face in public" or "never contradict him or the elders publicly". If women decide or influence family decisions, as they often do, their role has to be more private than public, more by applying reason than violence (Gamella 2000, Gamella & Martín 2007). In this sense, while gossiping is a fundamental weapon in the hands of women, violence is seen as the prerogative of males in extreme circumstances (Gay Blasco 1999, San Román 2010). There is obviously a lot of individual and couple's variation in these gender arrangements and age may also play an important moderation role, but this norm is clearly differential with respect to the majority population. Following the norm-psychology account, this cultural difference is hypothesized to be reflected in game behavior in that *Gitano* females should be more reluctant (than non-*Gitano* ones and males in general) to punish others in either condition of the experiment, given that *Gitano* males are always present.

2.3 Results

Contributions to the public good. With regard to the participants' cooperation, as measured by their contributions to the public good, the results are displayed in Figure 2. No main effect of ethnicity or condition on contributions is found (ps>0.10, OLS regression with robust standard errors and controlling for gender and age; see Figure 2a). The interaction between these two variables is not significant either (p>0.10) and all possible comparisons report ps>0.10 according to joint-significance Wald tests on the model estimates. Contribution levels were relatively high (well above 60% of the endowment on average; see Ledyard 1995). Given that the threat of punishment introduces incentives to cooperate strategically and therefore contributions do not

necessarily reflect a "pure" preference for cooperation, the finding of similar average contribution levels across cultural groups and conditions could be due to multiple factors.

However, we observe a significant interaction between gender and condition ($p<0.01$; see Figure 2b and 2c): across both cultural groups (especially among non-*Gitanos* although the three-way interaction ethnicity X condition X gender is not significant, $p>0.20$), we find that females contributed less in *homogenous* than in *mixed* groups ($p<0.05$, Wald test), while the opposite is observed for males (although not significantly so, $p=0.15$). As a result, males cooperated significantly less than females in *mixed* groups ($p<0.05$) but similarly in *homogeneous* groups ($p=0.40$).

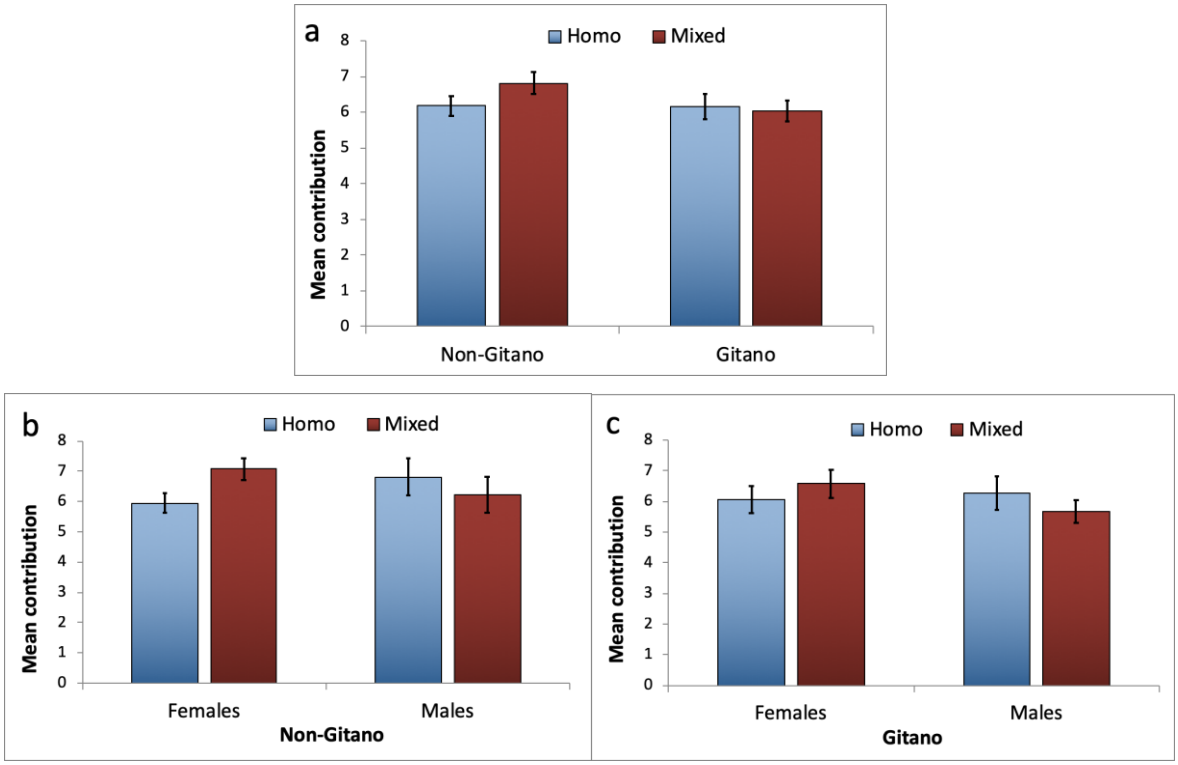


Figure 2. Mean contributions in homogeneous and mixed conditions. *Panel (a) displays the data broken down by ethnicity. Panels (b) and (c) display the data broken down by gender, for non-Gitanos and Gitanos, respectively. Error bars represent standard error of the mean.*

Aggregate punishment levels. Figure 3 summarizes the results regarding punishment behavior. We observe a significant main effect of ethnicity indicating that *Gitanos* punished in general less than non-*Gitanos* ($p<0.01$, OLS regression with robust standard errors clustered at both the group and the individual level, and controlling for condition, gender, age, the difference in contributions between the punisher and the target, and the mean contribution of the other two group members). The treatment condition does not yield a significant estimate ($p>0.10$). A significant ethnicity X condition interaction ($p<0.01$) reveals that in *homogeneous* groups *Gitanos* punished much less than their non-*Gitano* counterparts ($p<0.01$, Wald test) but there were no ethnic differences in *mixed* groups ($p=0.50$; see Figure 3a). The intergroup encounter triggered by the *mixed* condition thus exerted substantial and differential effects on both sides: *Gitanos* increased their punishment level ($p<0.01$) while non-*Gitanos* reduced it ($p<0.05$), as compared to the *homogenous* condition.

Yet, there is also a significant interaction between gender and condition ($p<0.01$): we observe a higher level of punishment implemented by males ($p<0.01$, Wald test) and a lower level of punishment implemented by females ($p<0.01$) in *mixed*, compared to *homogenous* groups (see Figure 3b and 3c). Although the three-way interaction ethnicity X condition X gender is not significant ($p=0.57$), it can be seen that *Gitano* females almost never used punishment in either condition. In other words, *Gitano* females' punishment was nearly inexistent regardless of the condition whereas the level of punishment implemented by *Gitano* males, which was negligible in *homogeneous* groups, turns out to be rather high in *mixed* groups. Among non-*Gitanos*, females punished less while males punished more in *mixed* than in *homogeneous* groups.

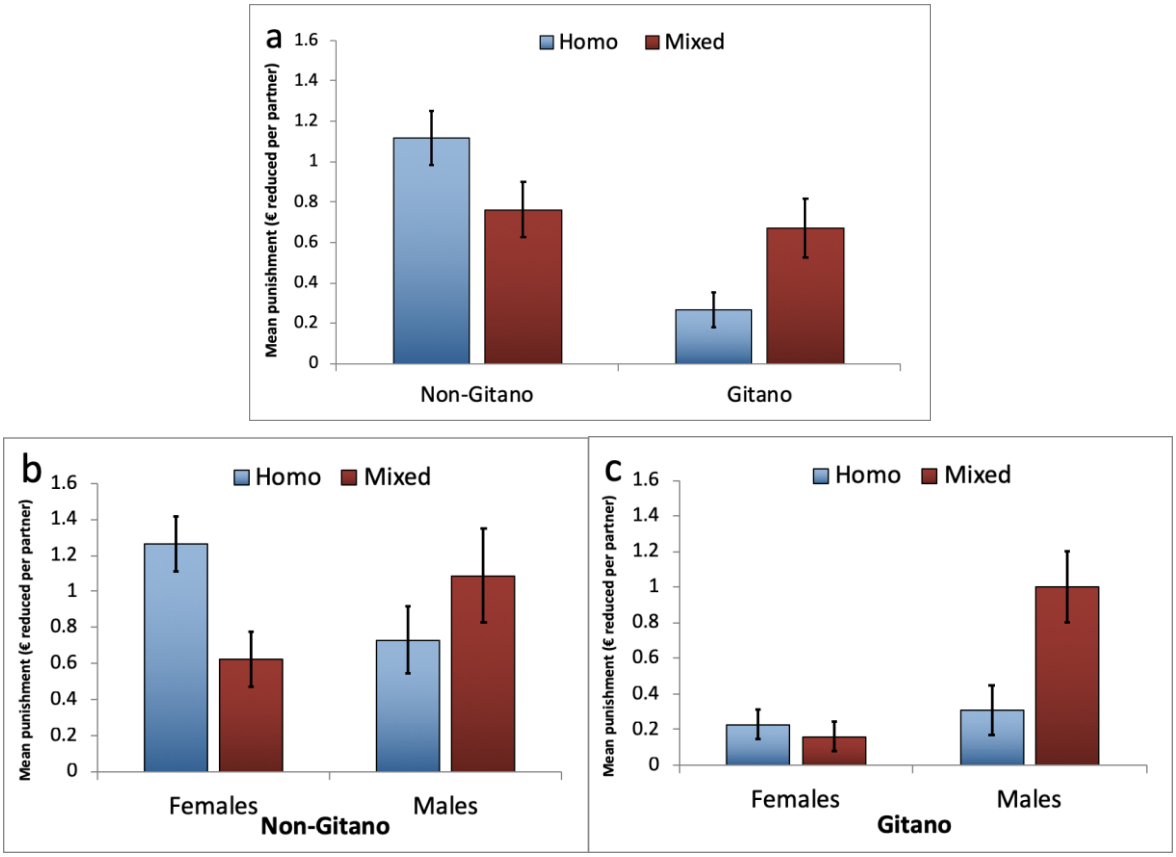


Figure 3. Mean aggregate punishment in homogeneous and mixed conditions. *Panel (a) displays the data broken down by ethnicity. Panels (b) (non-Gitanos) and (c) (Gitanos) display the data broken down by ethnicity and gender. Error bars represent robust standard error of the mean clustered at the group level.*

Altruistic and antisocial punishment. In all regressions, the higher the difference between the punisher's contribution and the target's contribution (punisher's minus target's) the stronger the punishment (ps<0.01), indicating that more intense wrongdoing metes out firmer punishment. However, we also observe some instances of spiteful, antisocial punishment targeted at cooperators. When disentangling between "altruistic" (the target contributed less than the punisher) and "antisocial" (the target contributed more than the punisher) punishment in panels (b) and (c) of Figure 4, we see that the rather strong punishment implemented by *Gitanos*, in particular males (panels c and d break down the data by gender), in *mixed* compared to *homogeneous* groups is due uniquely to altruistic punishment since their level of antisocial punishment was still very low in *mixed* groups. The remaining results mentioned above do not appear to crucially depend, at least qualitatively, on whether punishment is altruistic or antisocial.

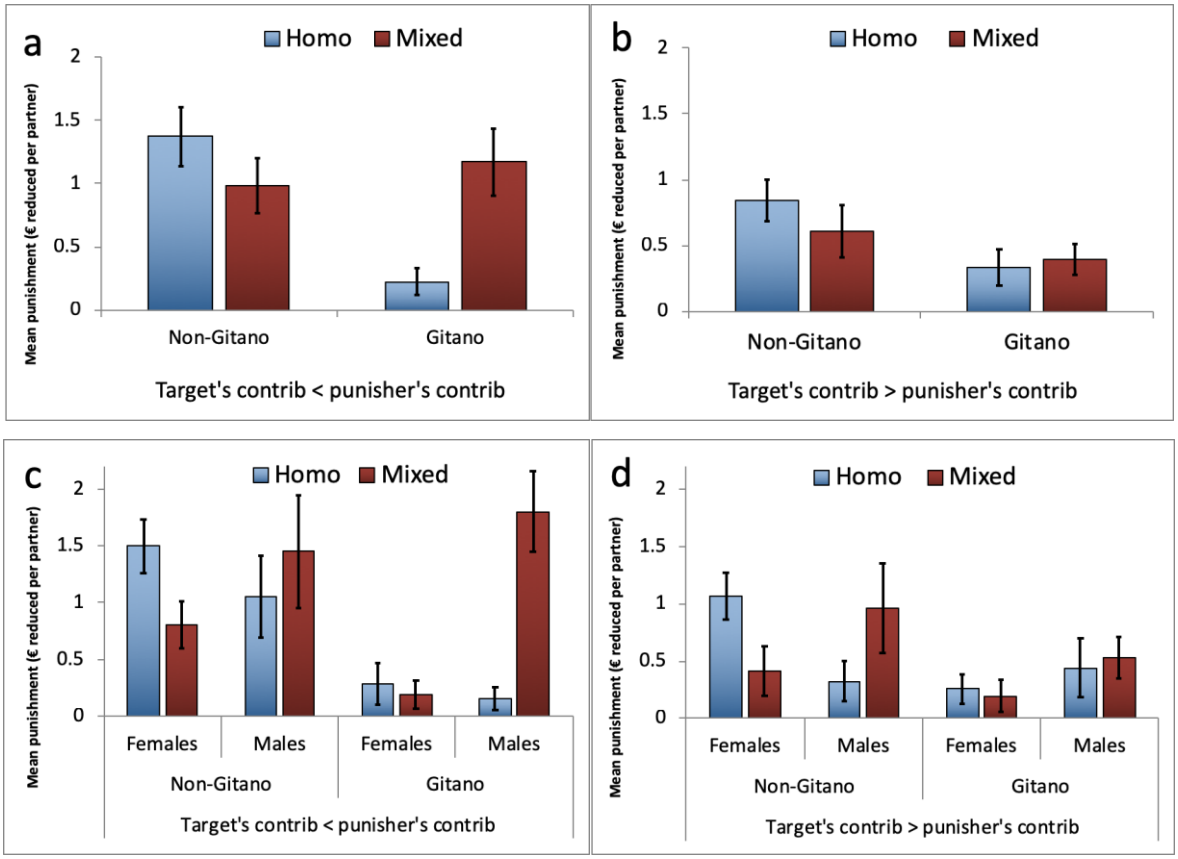


Figure 4. Mean altruistic and antisocial punishment in homogeneous and mixed conditions. *Panels (a) (altruistic punishment) and (b) (antisocial punishment) display the data broken down by punisher's ethnicity. Panels (c) (altruistic punishment) and (d) (antisocial punishment) display the data broken down by punisher's ethnicity and gender. Error bars represent robust standard error of the mean clustered at the group level*

Ethnocultural identities and punishment. It remains to know whether participants punished differently in *mixed* groups depending on the cultural identity of the target (recall that the target's ethnicity, but not her personal identity, was known to the punisher). In Figure 5, we display the mean punishment levels imposed on *Gitano* and non-*Gitano* targets in *mixed* groups. We find that, *regardless of the punisher's ethnicity*, *Gitano* targets received less antisocial punishment and more altruistic punishment than non-*Gitano* targets for the same behaviors (significant interaction between contribution difference and target's ethnicity, $p<0.01$, OLS regression; the triple interaction with punisher's ethnicity is not significant, $p>0.10$; see Figure 5a and 5b). Put differently, both *Gitano* and non-*Gitano* punishers were more responsive to the distance between theirs

and the target's contribution (i.e., to the level of wrongdoing) when the target was *Gitano* than when the target was non-*Gitano*. *Gitano* targets got punished significantly less than non-*Gitano* targets when they cooperated more than the punisher ($p<0.05$ for differences larger than €4; Wald test), whereas *Gitano* targets got punished more than non-*Gitano* ones when they cooperated less than the punisher ($p<0.05$ for differences larger than €3).

As can be seen in Figure 5c and 5d, the difference in altruistic punishment is exclusively due to male punishers, whereas the difference in antisocial punishment is similar across genders, although it appears to be stronger among non-*Gitano* female punishers.

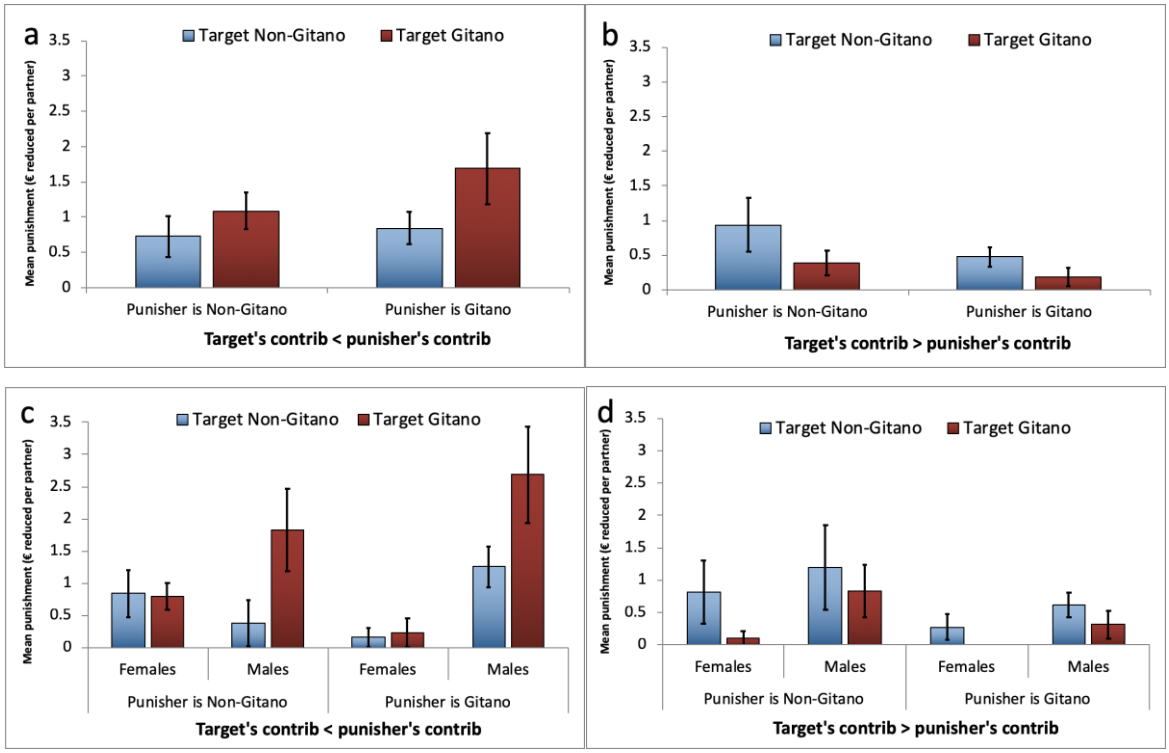


Figure 5. Mean punishment on Gitano and non-Gitano targets in mixed groups. *Panels (a) (altruistic punishment) and (b) (antisocial punishment) display the data broken down by punisher's ethnicity. Panels (c) (altruistic punishment) and (d) (antisocial punishment) display the data broken down by punisher's ethnicity and gender. Error bars represent robust standard error of the mean clustered at the group level.*

To summarize, *Gitanos* almost did not punish the misbehavior of other *Gitanos* in *homogeneous* groups but they, in particular males, punished it severely in *mixed* groups with non-*Gitanos*. Non-*Gitano* males, on the other hand, also retaliated more harshly against *Gitano* free-riders than against non-*Gitano* ones in *mixed* groups. Regarding antisocial punishment of cooperators, the results are somehow weaker: while participants tended to target more punishment at non-*Gitano* than *Gitano* cooperators in *mixed* groups, the levels of antisocial punishment were relatively low (especially compared to those of altruistic punishment).

***A closer look into the basic competing hypotheses*.** In Figure 6a we rearrange the above results regarding the altruistic punishment of free-riders in a manner that facilitates comparison with Table 1 and Figure 1, which presented the predictions of the two accounts. Although the big mistake hypothesis does not yield predictions about antisocial punishment targeted at cooperators, Figure 6b displays the results on antisocial punishment for the sake of completeness.

With regards to altruistic punishment (Figure 6a), from the *homogeneous* condition we observe, following the notation used in Table 1, that $I_G < I_{NG}$ ($p<0.01$; see above). Thus, the punishment targeted at ingroup free-riders in *homogeneous* groups is higher among non-*Gitanos* than among *Gitanos*, as predicted by the cultural group selection account. In *mixed* groups, we can see that I>O holds for *Gitanos*, indicating that ingroup free-riders get punished more firmly than outgroup ones, whereas the opposite is true for non-*Gitanos* ($p<0.05$ for differences between the punisher's and the target's contributions larger than €3 in both cases; see above). Here, the results for non-*Gitano* punishers do not fit into the basic predictions of any of the two accounts, but the results for *Gitano* punishers match the predictions of both accounts. Finally, we also observe that $I_H<I_M$ holds among *Gitanos* ($p<0.01$), meaning that ingroup free-riders get punished more in *mixed* than *homogeneous* groups, while the opposite is observed among non-*Gitanos* ($p<0.05$). Again, both accounts fail in predicting the behavior of non-*Gitano* punishers. The cultural group selection hypothesis, however, gives a good approximation to the behavior of *Gitano* punishers.

Figure 6c displays the results about altruistic punishment for male and female punishers separately. As mentioned earlier, *Gitano* females almost did not punish in any condition. In addition, the $I_G < I_{NG}$ finding from *homogeneous* groups and the $I_H>I_M$ one

for non-*Gitanos* hold qualitatively regardless of the punisher's gender, whereas the I>O (I<O) observed among *Gitanos* (non-*Gitanos*) in *mixed* groups as well as the $I_H<I_M$ among *Gitanos* are only driven by male punishers.

As for the antisocial punishment of cooperators (Figure 6b), the prediction of the cultural group selection hypothesis that outgroup cooperators should mete out more punishment than ingroup ones (I<O (*anti*) in Table 1) accurately describes the data when focusing on *Gitano* punishers. However, the opposite pattern (I>O (*anti*)) is observed among non-*Gitano* punishers, also against the predictions of the cultural group selection account ($p<0.05$ for differences between the target's and the punisher's contributions larger than €4 in both cases; see above). On the other hand, to the extent that the presence of ingroup-outgroup identity cues should make individuals direct any competitive desires (and efforts) towards the outgroup, a cultural group selection approach also predicts that $I_H>I_M$ (*anti*), that is, any instances of ingroup antisocial punishment existent in *homogeneous* groups must be suppressed in *mixed* groups. This prediction is met among *Gitano* punishers ($p<0.05$ for differences larger than €1) but not for non-*Gitano* ones ($p>0.10$ for all possible differences).

Breaking down the results on antisocial punishment by gender in Figure 6d, we see that both the I<O (*anti*) and $I_H>I_M$ (*anti*) findings for *Gitano* punishers hold qualitatively for both males and females (with the disclaimer that females punish very little), whereas the I>O (*anti*) observed for non-*Gitanos* is only driven by male punishers. Also, when comparing the ingroup antisocial punishment between *homogeneous* and *mixed* conditions among non-*Gitano* punishers we observe $I_H<I_M$ (*anti*) for males, that is, the opposite of what is predicted by the cultural group selection account and is met for *Gitano* punishers.

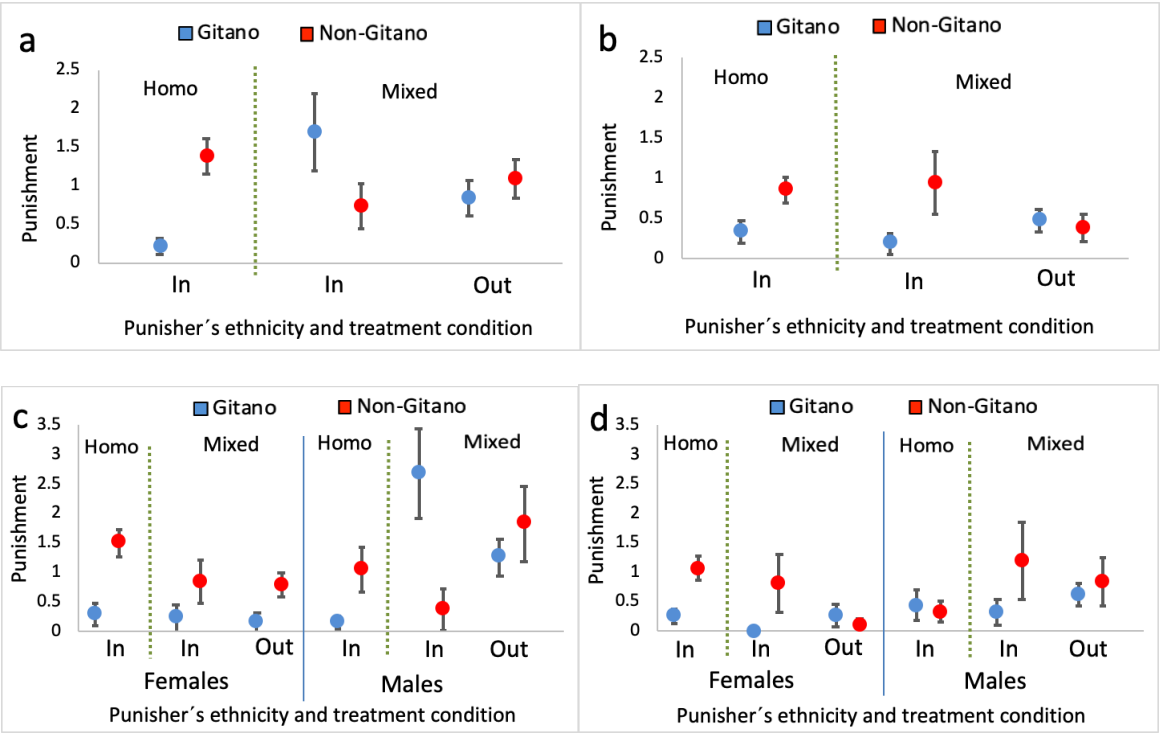


Figure 6. Mean altruistic and antisocial punishment targeted at ingroups and outgroups. *Panels (a) (altruistic punishment) and (b) (antisocial punishment) display the data broken down by punisher's ethnicity and treatment condition (ingroup-homogeneous, ingroup-mixed and outgroup-mixed). Panels (c) (altruistic punishment) and (d) (antisocial punishment) display the data broken down by punisher's ethnicity, treatment condition and punisher's gender. Error bars represent robust standard error of the mean clustered at the group level.*

2.4 Discussion

Our experiments yield new insights into the evolutionary roots of human prosocial behavior and altruistic punishment in particular. Given that *Gitanos*' use of punishment in *homogeneous* groups was nearly inexistent, especially compared to that of non-*Gitanos*, our data seem to be inconsistent with the "big mistake" or "mismatch" hypothesis. Under this hypothesis *Gitanos* should punish similarly or slightly more than non-*Gitanos* on average because, while being also "modern" humans (i.e., citizens of modern states), their social organization is more heavily based on kinship, family networks and closeness. The explanation would be that group-beneficial behaviors such

as altruistic punishment evolved at a time when nearly all social interactions were among relatives and reputation was always at stake. Thus, altruistic punishment would have been selected through kin selection and/or "traditional" reciprocity mechanisms given that its use tended to confer inclusive fitness benefits to the punisher in ancestral small-scale human groups. Such an evolved psychology should be equally or more clearly displayed by *Gitanos* who are still heavily organized around kinship and close relationships, in contrast to non-*Gitanos* who have more frequent sporadic encounters with non-relatives. Our results do not support this prediction.

On the other hand, if altruistic punishment is particularly important for the enforcement of cooperation among non-kin in large-scale societies, as argued by theorists of cultural group selection, non-*Gitanos* should punish more than *Gitanos* in *homogeneous* groups. This is what we observe. The results from Henrich & Henrich (2014) suggest that relatedness might reduce the willingness to punish others, since they found that individuals more genetically related to the average member of the "yavusa" in a Yasawan sample (Fiji Islands) tended to punish less as third-party observers. Moreover, in such a highly genetically related population, punishment was comparatively infrequent, and zero offers were very often accepted in both ultimatum and third-party punishment games, whereas actual offers were on average quite high (i.e., "fair"). This matches the ultimatum game results of Brañas-Garza et al. (2006) with a sample of Spanish *Gitanos* in Madrid, where high levels of cooperation were observed in the form of high offers even though much lower offers would have gone unpunished. In cultural groups organized around kinship-based networks, peer punishment may not be favored to enforce daily-life group cooperation if other mechanisms such as gossiping or centralized punishment institutions represent lower-cost solutions (given the short-run negative impact of punishment on the fitness of individuals who share genes with the punisher). Indeed, previous theoretical evidence suggests that punishment is typically selected against in environments of high genetic relatedness (Gardner & West 2004). Recent advances also indicate that public multilateral cooperation can evolve by kin selection in sizeable groups, in the absence of punishment, if genetic relatedness is strong enough (values observed today in small-scale populations may suffice, e.g., Walker 2014) so that indirect inclusive fitness benefits act as a sufficiently powerful cooperation-enhancing force (Rusch 2017). Relatedly, experimental research suggests that cooperation, but *not* punishment, increases with cues of kin density in PGP groups (Krupp et al. 2008). The

exact role of genetic relatedness for punishment behavior is yet to be systematically assessed, however.

In addition, as opposed to the arguments of the mismatch hypothesis, the existence of cultural selection processes predicts different manifestations of the same behavior (i.e., punishment toward members one's own cultural group) in intergroup encounters compared to situations where group identity cues are absent, and this is again what we observe. *Gitanos* (but only males), who have a strong sense of ethnic identity, targeted punishment at *Gitano* wrongdoers when they interacted with non-*Gitanos* in *mixed* groups but not in only-*Gitano homogeneous* groups. This observation is consistent with the hypothesis that punishment plays an important role in the evolution of cooperation through its impact on intergroup processes. At the proximate level, we interpret this result as reflecting that *Gitano* males use punishment only in response to a clear group identity threat (Akerlof & Kranton 2000, Bénabou & Tirole 2011): that of being seen as less cooperative than non-*Gitanos*. The negative emotions triggering punishment (Fehr & Gächter 2002, Tabibnia et al. 2008, Crockett et al. 2013) among *Gitanos* would thus emanate from the possibility of comparison between the two ethnic groups. Previous research indicates that, during intergroup contact, feelings of identity threat are particularly likely to be aroused among individuals with a stronger group identification (Dovidio et al. 2008, Crisp et al. 2006). It can be inferred thus that the key norm for *Gitanos* (that which is to be enforced), is not cooperation *per se* but preserving an ethnic identity of which they are proud.[5] This result is to a large extent coherent with previous results from ultimatum game experiments (McLeish & Oxoby 2007, 2011, Mendoza et al. 2014) and multilateral gift-giving (non-standard) third-party punishment games (Shinada et al. 2004) using identity manipulations.

However, the latter finding seems at odds with results from standard third-party punishment experiments in which harsher punishment has been observed when the victim is an ingroup of the third-party (i.e., the punisher) and the norm violator is an outgroup,

[5] Indeed, in the *homogeneous* condition, a common comment by *Gitano* participants during the post-experimental interview when informally asked about their perception of punishment opportunities (i.e., "the possibility of reducing others' earnings") was that punishing others makes no sense at all. "Destroying others' money and paying for it!" (subject #25) was seen as something weird, irrational and very negative, by *Gitanos* in the *homogeneous* condition. This type of comment was inexistent in the *mixed* condition (as well as in the only-non-*Gitano homogeneous* condition), as if the reasons for punishing others were evident for everyone.

compared to other combinations (Bernhard et al. 2006, Baumgartner et al. 2013, Goette et al. 2006, Jordan et al. 2014, Schiller et al. 2014, Rabellino et al. 2016; but see Shinada et al. 2004 for a non-standard design with different results). Yet there are important differences between the multilateral cooperation environment of our PGP and the framework posed by the third-party punishment game in those experiments. For instance, the punisher is directly affected by the norm violation in the former but not in the latter. Also, both ingroups and outgroups can be victims (and observers) of the norm violation at the same time in the PGP but not in the third-party punishment game. Likewise, punishers might have been more cooperative than the target, or less, in the third-party punishment game, but this fundamental detail—which informs about the true nature of punishment (Brañas-Garza et al. 2014, Espín et al. 2015, Herrmann et al. 2008)—is by design unknown (but see Shinada et al. 2004), in contrast to the PGP. Exploring the possible reasons for the inconsistencies between experimental frameworks is an interesting endeavor for future research.

Non-*Gitano* males' sanctioning behavior, on the other hand, is closer to what previous experiments using (standard) third-party punishment games have shown: they punish harshly outgroup wrongdoers but not ingroup ones in *mixed* groups. Indeed, the lowest level of altruistic punishment by non-*Gitano* males is observed when the wrongdoer is an ingroup and there are outgroup "third-party" victims, whereas the maximum level of punishment is targeted at outgroup wrongdoers when there are ingroup third-party victims. When both the wrongdoer and the third-party victims are ingroups (i.e., in *homogenous* groups), their punishment remains at intermediate levels. Seen in this way, these behavioral patterns resemble previous observations from third-party punishment games (see for instance Bernhard et al. 2006). Non-*Gitanos*' punishment behavior in *mixed* groups, therefore, seems inconsistent with the basic predictions of cultural group selection theories—but also with those of the mismatch hypothesis. It might be that the lower strength of group identity or the majority status of non-*Gitanos* (see below) contribute to explain this finding and the discrepancy with *Gitanos*' punishment behavior, which aligns well with the predictions of cultural group selection in both *homogeneous* and *mixed* groups.

In addition, we find some indication that *Gitanos* spitefully punished non-*Gitanos* cooperators more than *Gitano* ones (i.e., more antisocial punishment targeted at outgroups

than ingroups). This result is in line with the prediction of cultural group selection theories as well but the level of antisocial punishment in *mixed* groups was perhaps too low to draw any firm conclusion.

Taken together, these results highlight the complexity of inter-ethnic relationships for both the provision of public goods and the enforcement of cooperation. The role of majority versus minority status of groups, which has been largely overlooked in previous research on punishment behavior in intergroup encounters, might be crucial. As mentioned, *Gitano* non-cooperators were firmly punished by other (male) *Gitanos* in *mixed* groups, but also by (male) non-*Gitanos*. The fact that ethnic minorities, and Romani groups in particular, are often perceived as if not following the collective action norms of the majority (Weyrauch 2001, Martín & Gamella 2005, Marushiakova & Popov 2007) and as potentially violent in their reactions to the majority's enforcement institutions (Gay Blasco 1999, San Román 2010, Cantón 2010), may explain the strong punishment of *Gitano* wrongdoers by non-*Gitano* males. This result could be reflecting the opportunity provided by the experimental anonymous setting for the majority to sanction the minority without fearing retaliation, probably symptomatic of a sense of moral superiority (Brewer 1999) or pretended assimilation (Dovidio et al. 2008). Further research should explore these possibilities in greater detail. Note that non-*Gitanos* typically do not share such a strong group identity as *Gitanos* due, in part, to their majority status. Indeed, groups' majority/minority status is a predictable, although imperfect, correlate of group identity strength that shapes intergroup encounters in many ways (Dovidio et al. 2008). Previous evidence indicates that members of majority status groups are typically more concerned with not being perceived as prejudiced by the minority, whereas members of minority groups are concerned with becoming the target of the majority's prejudice (Tropp & Pettigrew 2005, Shelton 2003). Since an extended stereotype is that *Gitanos* do not contribute to the commons and display low compliance with the majority collective action norms, following those arguments, it might be natural that both non-*Gitanos* and *Gitanos*, although for different reasons, punish acts that confirm the stereotype (i.e., *Gitanos* not cooperating) more firmly than acts that contradict it (i.e., non-*Gitanos* free-riding or *Gitanos* cooperating). This would be consistent with our findings.

An important aspect uncovered by our experiments relates to the impact of gender roles within as well as across cultural groups. While females contribute more in *mixed* than *homogeneous* groups, the opposite is observed for males. Also, in contrast to what we see among females, males punish generally more in *mixed* than *homogeneous* groups (consistent with a "male-warrior" account; Mathew & Boyd 2011, Van Vugt et al. 2007, McDonald et al. 2012). These two results hold similarly for both *Gitano* and non-*Gitano* participants, thus suggesting the existence of gender differences common to both cultural groups. One candidate proximate force underlying such gender differences is risk aversion. If *mixed* groups are perceived as risky environments due to the presence of outgroups, probably the safest strategy is to avoid conflict by cooperating and not punishing others (to the extent that the punished individual cannot learn the ethnic identity of the punisher, punishment not only of outgroups but also of ingroups may trigger conflict). Since there is abundant evidence suggesting that, at least in patriarchal societies, males are less risk averse than females (e.g., Jianakoplos & Bernasek 1998, Charness & Gneezy 2012; for studies suggesting a biologically-informed explanation see, for instance, Brañas-Garza et al. 2017 and Brañas-Garza & Rustichini 2011), this might explain why they tend to use such a strategy to a lesser extent than females.

However, while non-*Gitano* females' punishment was strongly modulated by group type—high in *homogeneous* and low in *mixed* groups—*Gitano* females almost did not punish in either condition. This result may be reflecting a culture-specific differential role of females and males on norm enforcement. Indeed, the finding is consistent with the evidence reviewed earlier suggesting that the *Gitano* cultural norms prescribe women to reduce their assertiveness in the presence of (*Gitano*) males, who should ostensibly lead social interactions in such situations. These marked gender roles are far less prevalent in the majority population.

In sum, while our results are more consistent with cultural group selection theories and their associated norm-psychology account than with misfiring-based theories, several findings challenge a strict view of how cultural group selection processes should translate into behavioral outcomes. These findings in fact raise a number of new questions that deserve further exploration.

2.5 Methods

Five semi-rural towns in southern Spain (Granada, Andalusia) with comparable demographic characteristics hosted our experiments: Benalúa de Guadix, Darro, Deifontes, Iznalloz and Pedro Martínez (see Figure 7a). Recruitment of non-*Gitano* participants was made through the Town Halls (the activity was publicly announced as a study for the University of Granada, and individuals stated to the Hall's staff their interest in participating). Town Halls however did not provide a good means to contact *Gitanos* since they are typically less involved in Towns' official collective activities. To recruit *Gitano* participants, two of the main researchers visited several households in the weeks preceding the experiment and asked the (previously-known) family heads to "bring some of their folks". As call for participation, there was a €5 show-up fee and a drink and "*tapa*" at the end of the experiment.

In each location, we ran two experimental sessions in a between-subjects design: one ethnically *homogeneous* session (either all *Gitanos*, in two locations, or all non-Gypsies, in three locations) and one ethnically *mixed* session (same number of *Gitanos* and non-*Gitanos*; one session in each of the five locations) where ethnic identity was made salient. We ensured that subjects in one session did not learn the ethnic composition of the other session prior to participating. In each of the 10 sessions, 32 participants played the PGP in eight independent four-people groups. The participants were initially evenly assigned to one out of four colors using visible colored scarves. Assignment to colors was performed randomly in *homogenous* sessions but was dependent on ethnicity in *mixed* sessions, so that two colors were associated to *Gitanos* and the other two colors to non-*Gitanos*. This procedure was unknown to participants and was implemented by giving scarves of identical color to those participants who showed-up together. Since *Gitanos* and non-*Gitanos* always arrived separately, the resulting assignment of colors to ethnic groups was nearly perfect (see below).

In *mixed* sessions, we subtly induced participants to realize the link between colors and ethnicities prior to play the game—we made public who composed each color also in *homogenous* sessions in order to allow for comparability across conditions—: the eight participants of each color were placed together wearing their scarves and were photographed by an assistant in front of the other participants. This feature of the design allowed participants to associate cooperation decisions to ethnicities (i.e., colors) and

condition their punishment decisions upon the ethnicity of the target. Data from post-experimental interviews indicate that most participants were able to associate ethnicities to scarf colors in *mixed* sessions (even if socially-desirable responding might have reduced their willingness to acknowledge this). See Figure 7b for a representation of the structure of the experiment.

For the statistical analyses we excluded seven participants; two *Gitanos* because they participated in a *homogeneous* non-*Gitano* session by coincidence (we learned their ethnicity ex-post) and five individuals from four different *mixed* sessions because their ethnicity did not match their color (including them does not qualitatively affect the results). The final sample consists of 143 *Gitanos* and 170 non-*Gitanos*.

The basic elements of the PGP design have been reported elsewhere (Espín et al. 2012). Each four-person PGP group was composed of one randomly selected person from each color. Beyond colors, group membership was unknown. After deciding how much from an endowment of €10 to contribute to a public good (marginal per capita return = 0.5; thus each Euro contributed cost 50 cents to the individual but increased each of the other three group members' earnings by 50 cents), participants received feedback on their group partners' contributions and earnings in a color-based fashion and could then anonymously reduce other group members' payoffs at personal cost (cost-to-impact ratio of punishment = 1:3). Finally, participants were also asked to state the level of punishment they expected from each group partner (no monetary incentives were used for this task). Several examples of all stages of the PGP were displayed on a whiteboard to facilitate understanding of the game rules. After the PGP, participants completed an unrelated task. At the end of the experiment, participants were privately asked to answer a set of socio-demographic questions and received their payment. Mean earnings from the PGP were €13.34 ±4.08 (SD).

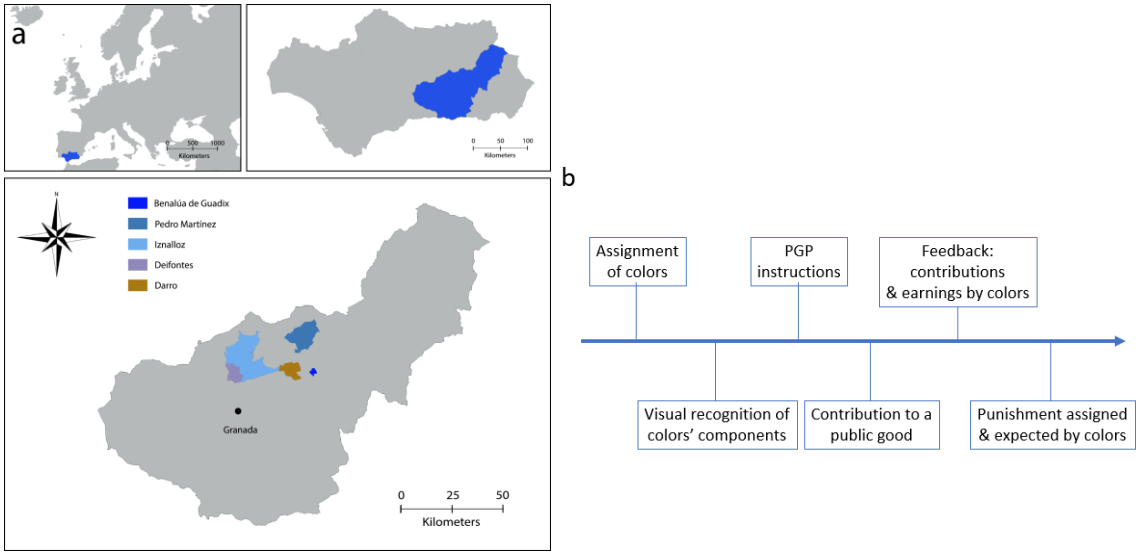


Figure 7*. Panel (a) Five semi-rural towns in southern Spain (Granada, Andalusia): Benalúa de Guadix, Darro, Deifontes, Iznalloz and Pedro Martínez. Panel (b) Structure of the experiment.*

Ethics statement

All participants provided consent prior to participation. Oral informed consent was obtained because literacy was not a requirement to participate due to the (expected) low educational level of many participants; only being able to read and write numbers was required to participate. This study was conducted in accordance with the Declaration of Helsinki for human research. All participants were treated anonymously by assigning them a numerical code in accordance with the Spanish Law 15/1999 on Personal Data Protection.

References

Akerlof, G. A., & Kranton, R. E. (2000). Economics and identity. *The Quarterly Journal of Economics*, *115*(3), 715-753.

Álvarez-Roldán, A., Parra, I., & Gamella, J. F. (2018). Reasons for the underachievement and school drop out of Spanish Romani adolescents. A mixed methods participatory study. *International Journal of Intercultural Relations*, *63*, 113-127.

Axelrod, R., & Hamilton, W. D. (1981). The evolution of cooperation. *Science*, *211*(4489), 1390-1396.

Baumgartner, T., Schiller, B., Rieskamp, J., Gianotti, L. R., & Knoch, D. (2013). Diminishing parochialism in intergroup conflict by disrupting the right temporo-parietal junction. *Social Cognitive and Affective Neuroscience*, nst023.

Bénabou, R., & Tirole, J. (2011). Identity, morals, and boos: Beliefs as assets. *The Quarterly Journal of Economics*, *126*(2), 805-855.

Benet-Martínez, V., Leu, J., Lee, F., & Morris, M. W. (2002). Negotiating biculturalism cultural frame switching in biculturals with oppositIonal versus compatible cultural identities. *Journal of Cross-Cultural Psychology*, *33*(5), 492-516.

Bernhard, H., Fischbacher, U., & Fehr, E. (2006). Parochial altruism in humans. *Nature*, *442*(7105), 912-915.

Bowles, S. (2006). Group competition, reproductive leveling, and the evolution of human altruism. *Science*, *314*(5805), 1569-1572.

Boyd, R., & Richerson, P. J. (1988). The evolution of reciprocity in sizable groups. *Journal of Theoretical Biology*, *132*(3), 337-356.

Boyd, R., Gintis, H., Bowles, S., & Richerson, P. J. (2003). The evolution of altruistic punishment. *Proceedings of the National Academy of Sciences*, *100*(6), 3531-3535.

Brañas-Garza, P., & Rustichini, A. (2011). Organizing effects of testosterone and economic behavior: Not just risk taking. *PloS One*, *6*(12), e29842.

Brañas-Garza, P., Cobo-Reyes, R., & Domínguez, A. (2006). "Si él lo necesita": Gypsy fairness in Vallecas. *Experimental Economics*, *9*(3), 253-264.

Brañas-Garza, P., Espín, A. M., Exadaktylos, F., & Herrmann, B. (2014). Fair and unfair punishers coexist in the Ultimatum Game. *Scientific Reports*, *4*, 6025.

Branas-Garza, P., Galizzi, M., & Nieboer, J. (2017). Experimental and self-reported measures of risk taking and digit ratio (2D: 4D): evidence from a large, systematic study. *International Economic Review*.

Brewer, M. B. (1999). The psychology of prejudice: Ingroup love and outgroup hate?. *Journal of social issues*, *55*(3), 429-444.

Burnham, T. C., & Johnson, D. D. (2005). The biological and evolutionary logic of human cooperation. *Analyse und Kritik*, *27*(1), 113.

Calderón, R., Aresti, U., Ambrosio, B., & González-Martín, A. (2009). Inbreeding Coefficients for X-linked and Autosomal Genes in Consanguineous Marriages in Spanish Populations: The Case of Guipúzcoa (Basque Country). *Annals of Human Genetics*, *73*(2), 184-195.

Cantón, M. (2010) "Gypsy Pentecostalism, Ethnopolitical Uses and Construction of Belonging in the South of Spain". *Social Compass (International Review of Sociology of Religion)*, Vol. 57, nº 2, pp. 253-267.

Charness, G., & Gneezy, U. (2012). Strong evidence for gender differences in risk taking. *Journal of Economic Behavior & Organization*, *83*(1), 50-58.

Chudek, M., & Henrich, J. (2011). Culture–gene coevolution, norm-psychology and the emergence of human prosociality. *Trends in Cognitive Sciences*, *15*(5), 218-226.

Cosmides, L., & Tooby, J. (1992). Cognitive adaptations for social exchange. *The Adapted Mind*, 163-228.

Crisp, R. J., Walsh, J., & Hewstone, M. (2006). Crossed categorization in common ingroup contexts. *Personality and Social Psychology Bulletin*, *32*(9), 1204-1218.

Crockett, M. J., Apergis-Schoute, A., Herrmann, B., Lieberman, M. D., Müller, U., Robbins, T. W., & Clark, L. (2013). Serotonin modulates striatal responses to fairness and retaliation in humans. *The Journal of Neuroscience*, *33*(8), 3505-3513.

De Quervain, D. J., Fischbacher, U., Treyer, V., & Schellhammer, M. (2004). The neural basis of altruistic punishment. *Science*, *305*(5688), 1254.

Delton, A. W., Krasnow, M. M., Cosmides, L., & Tooby, J. (2011). Evolution of direct reciprocity under uncertainty can explain human generosity in one-shot encounters. *Proceedings of the National Academy of Sciences*, *108*(32), 13335-13340.

Dovidio, J. F., Gaertner, S. L., & Saguy, T. (2008). Another view of "we": Majority and minority group perspectives on a common ingroup identity. *European Review of Social Psychology*, *18*(1), 296-330.

Dreber, A., Rand, D. G., Fudenberg, D., & Nowak, M. A. (2008). Winners don't punish. *Nature*, *452*(7185), 348-351.

Espín, A. M., Brañas-Garza, P., Herrmann, B., & Gamella, J. F. (2012). Patient and impatient punishers of free-riders. *Proceedings of the Royal Society of London B: Biological Sciences*, rspb20122043.

Espín, A. M., Exadaktylos, F., Herrmann, B., & Brañas-Garza, P. (2015). Short-and long-run goals in ultimatum bargaining: impatience predicts spite-based behavior. *Frontiers in Behavioral Neuroscience*, *9*, 214.

Fehr, E., & Gächter, S. (2002). Altruistic punishment in humans. *Nature*, *415*(6868), 137-140.

Fehr, E., & Gintis, H. (2007). Human motivation and social cooperation: Experimental and analytical foundations. *Annu. Rev. Sociol.*, *33*, 43-64.

Fehr, E., Fischbacher, U., & Gächter, S. (2002). Strong reciprocity, human cooperation, and the enforcement of social norms. *Human Nature*, *13*(1), 1-25.

Finkler, K., Dolgin, J., Franklin, S., Gusterson, H., Hadler, N. M., Evans, J. P., ... & Finkler, K. (2001). The kin in the gene: the medicalization of family and kinship in American society. *Current anthropology*, *42*(2), 235-263.

Fraser, A. (1992). *The Gypsies: The People of Europe*. Oxford: Blackwell Publishers

FSG (2008) *Mapa sobre vivienda y comunidad gitana en España, 2007*. Madrid: Fundación Secretariado Gitano.

Fuster, V., & Colantonio, S. (2004). Socioeconomic, demographic, and geographic variables affecting the diverse degrees of consanguineous marriages in Spain. *Human Biology*, *76*(1), 1-14.

Fuster, V., & Colantonio, S. E. (2002). Consanguinity in Spain: socioeconomic, demographic, and geographic influences. *Human Biology*, 301-315.

Gächter, S., & Herrmann, B. (2009). Reciprocity, culture and human cooperation: previous insights and a new cross-cultural experiment. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *364*(1518), 791-806.

Gächter, S., Renner, E., & Sefton, M. (2008). The long-run benefits of punishment. *Science*, *322*(5907), 1510-1510.

Gamella, J. F. (2000). *Mujeres gitanas: matrimonio y género en la cultura gitana de Andalucía*. Junta de Andalucía.

Gamella, J. F. (2011). *Historias de éxito. Modelos para reducir el abandono escolar de la adolescencia gitana.* Madrid: IFIIE, Ministerio de Educación.

Gamella, J. F., Carrasco-Muñoz, E. M., & Núñez Negrillo, A. M. (2013). Oculocutaneous Albinism and Consanguineous Marriage among Spanish *Gitanos* or Calé–A Study of 83 Cases. *Collegium Antropologicum*, *37*(3), 723-734.

Gamella, J. F., Carrasco-Muñoz, E. M., & Quesada Garrido, A. (2014a). New methodological approaches in the anthropological demography of Romani groups. An example from the study of the evolution of the infant and child mortality of the *Gitanos* or Calé of Spain (1871-2007). *Sociologia: Revista da Faculdade de Letras da Universidade do Porto, 4*, 175-204.

Gamella, J. F., Gómez Alfaro, A., & Pérez Pérez, J. (2014b). Nominal Assimilation: The Ethnic and National Identities of the *Gitanos* or Calé of Spain as Shown by their Surnames in the 1783–1785 Census. *Names*, *62*(3), 147-164.

Gamella, J. F., Martín, E. (2007). Vien avec moi cousine. Le mariage entre cousins germains chez le Gitans Andalous. *Etudes Tsiganes*, 30, 110-151.

Gamella, J. F. (2019). Consanguineous marriages among the *Gitanos* or Calé of Spain. A genealogical analysis (1900-2006). *Mimeo*

Gardner, A., & West, S. A. (2004). Cooperation and punishment, especially in humans. *The American Naturalist*, *164*(6), 753-764.

Gay Blasco, P. (1999). *Gypsies in Madrid: Sex, gender and the performance of identity*. Bloomsbury Academic.

Giddens, A. (1990). *The consequences of modernity*. Cambridge: Polity.

Gintis, H., Bowles, S., Boyd, R., & Fehr, E. (2003). Explaining altruistic behavior in humans. *Evolution and Human Behavior*, *24*(3), 153-172.

Goette, L., Huffman, D., & Meier, S. (2006). The impact of group membership on cooperation and norm enforcement: Evidence using random assignment to real social groups.

Gómez Alfaro A. (1999). Tipologías. Matrimonios mixtos y mestizajes gitanos en los censos históricos andaluces. *Demófilo*, *30*, 30–52.

Gómez Alfaro, A. (1998). Gitanos de Priego de Córdoba: entre el acoso y la supervivencia. *Legajos. Cuadernos de investigación histórica del sur de Córdoba*, *1*, 61-72.

Hagen, E. H., & Hammerstein, P. (2006). Game theory and human evolution: A critique of some recent interpretations of experimental games. *Theoretical Population Biology*, *69*(3), 339-348.

Hamilton, W. D. (1964). The genetical evolution of social behaviour. *Journal of Theoretical Biology*, *7*, 1-52.

Henrich, J., & Boyd, R. (2001). Why people punish defectors: Weak conformist transmission can stabilize costly enforcement of norms in cooperative dilemmas. *Journal of Theoretical Biology*, *208*(1), 79-89.

Henrich, J. (2004). Cultural group selection, coevolutionary processes and large-scale cooperation. *Journal of Economic Behavior & Organization*, *53*(1), 3-35.

Henrich, J., Mcelreath, R., Barr, A., Ensminger, J., Barrett, C., Bolyanatz, E., ... & Gwako, E. (2008). 2006 Costly punishment across human societies. Science 312, 1767–1770. In *University of California*.

Henrich, J., & Henrich, N. (2014). Fairness without punishment: behavioral experiments in the Yasawa Island, Fiji. In *Experimenting with social norms: Fairness and punishment in cross-cultural perspective*, 171-218.

Henrich, J. (2015). *The secret of our success: How culture is driving human evolution, domesticating our species, and making us smarter*. Princeton University Press.

Herrmann, B., Thöni, C., & Gächter, S. (2008). Antisocial punishment across societies. *Science*, *319*(5868), 1362-1367.

Hong, Y. Y., Morris, M. W., Chiu, C. Y., & Benet-Martinez, V. (2000). Multicultural minds: A dynamic constructivist approach to culture and cognition. *American Psychologist*, *55*(7), 709.

Hu, Y., Strang, S., & Weber, B. (2015). Helping or punishing strangers: neural correlates of altruistic decisions as third-party and of its relation to empathic concern. *Frontiers in Behavioral Neuroscience*, *9*, 24.

Jianakoplos, N. A., & Bernasek, A. (1998). Are women more risk averse?. *Economic inquiry*, *36*(4), 620-630.

Johnson, D. D., Stopka, P., & Knights, S. (2003). Sociology (communication arising): The puzzle of human cooperation. *Nature*, *421*(6926), 911-912.

Jordan, J. J., McAuliffe, K., & Warneken, F. (2014). Development of in-group favoritism in children's third-party punishment of selfishness. *Proceedings of the National Academy of Sciences*, *111*(35), 12710-12715.

Kende, A., Hadarics, M. and Lášticová, B. (2017) Anti-Roma Attitudes as Expressions of Dominant Social Norms in Eastern Europe. International Journal of Intercultural Relations, 60: 12-27. DOI: doi.org/10.1016/j.ijintrel.2017.06.002

Krasnow, M. M., Cosmides, L., Pedersen, E. J., & Tooby, J. (2012). What are punishment and reputation for?. *PloS one*, *7*(9), e45662.

Krupp, D. B., Debruine, L. M., & Barclay P. (2008). A cue of kinship promotes cooperation for the public good. *Evolution & Human Behavior, 29*, 49–55.

Lamba, S., & Mace, R. (2011). Demography and ecology drive variation in cooperation across human populations. *Proceedings of the National Academy of Sciences*, *108*(35), 14426-14430.

Leblon, B. (1985). *Les Gitans d'Espagne*. Paris: Presses Universitaires de France.

Ledyard, J. (1995). Public goods: A survey of experimental research. *The Handbook of Experimental Economics*. Princeton University Press.

Lehmann, L., Rousset, F., Roze, D., & Keller, L. (2007). Strong reciprocity or strong ferocity? A population genetic view of the evolution of altruistic punishment. *The American Naturalist*, *170*(1), 21-36.

Martin, E., & Gamella, J. F. (2005). Marriage practices and ethnic differentiation: The case of Spanish Gypsies (1870–2000). *The History of the Family*, *10*(1), 45-63.

Marushiakova, E., & Popov, V. (2007). The Gypsy court in eastern Europe. *Romani Studies*, *17*(1), 67-101.

Mathew, S., & Boyd, R. (2011). Punishment sustains large-scale cooperation in prestate warfare. *Proceedings of the National Academy of Sciences*, *108*(28), 11375-11380.

Matras, Y. (2015). *The Romani Gypsies*. Harvard University Press.

Mendoza, S. A., Lane, S. P. & Amodio, D. M. *For members only ingroup punishment of fairness norm violations in the ultimatum game*. *Soc. Psychol. Pers. Sci.* **5**, 662–670 (2014).

McDonald, M. M., Navarrete, C. D., & Van Vugt, M. (2012). Evolution and the psychology of intergroup conflict: the male warrior hypothesis. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *367*(1589), 670-679.

McLeish, K. N., & Oxoby, R. J. (2007). Identity, cooperation, and punishment. *IZA Discussion Paper No. 2572*.

McLeish, K. N., & Oxoby, R. J. (2011). Social interactions and the salience of social identity. *Journal of Economic Psychology*, *32*(1), 172-178.

Mesoudi, A. (2016). Cultural evolution: integrating psychology, evolution and culture. *Current Opinion in Psychology*, *7*, 17-22.

Nowak, M. A. (2006). Five rules for the evolution of cooperation. *Science*, *314*(5805), 1560-1563.

Núñez Negrillo, A. (2015). *Un siglo de matrimonios consanguíneos en la archidiócesis de Granada (1900-1999). Un análisis antropológico.* Doctoral Dissertation. Universidad de Granada.

Ogbu, J. U., & Simons, H. D. (1998). Voluntary and involuntary minorities: a cultural-ecological theory of school performance with some implications for education. *Anthropology & Education Quarterly*, *29*(2), 155-188.

Oliver, P. (1980). Rewards and punishments as selective incentives for collective action: theoretical investigations. *American Journal of Sociology*, *85*, 1356-1375.

Pasqualino, C. (1998). *Dire le chant. Les Gitanes Flamencos d'Andalousie*. Paris: CNRS Editions.

Peiró, E. W. (2012). *White Gypsies: Race and stardom in Spanish musical films*. University of Minnesota Press.

Piasere, L. (2004). *I rom d'Europa: una storia moderna*. GLF editori Laterza.

Piasere, L. (2012). Scenari dell'antiziganismo. Firenze: SEID Editori.

Pinel, E. C. (1999). Stigma consciousness: the psychological legacy of social stereotypes. *Journal of Personality and Social Psychology*, *76*(1), 114.

Pym, R. (2007). *The Gypsies of early modern Spain, 1425-1783*. London: Palgrave Macmillan.

Rabellino, D., Morese, R., Ciaramidaro, A., Bara, B. G., & Bosco, F. M. (2016). Third-party punishment: altruistic and anti-social behaviours in in-group and out-group settings. *Journal of Cognitive Psychology*, 1-10.

Reher, D. S. (1998). Family ties in Western Europe: persistent contrasts. *Population and Development Review, 24*(2), 203-234.

Richerson, P. J., & Boyd, R. (2008). *Not by genes alone: How culture transformed human evolution*. University of Chicago Press.

Richerson, P., Baldini, R., Bell, A. V., Demps, K., Frost, K., Hillis, V., ... & Ross, C. (2016). Cultural group selection plays an essential role in explaining human cooperation: A sketch of the evidence. *Behavioral and Brain Sciences*, *39*.

Rusch, H. (2017). Ancestral kinship patterns substantially reduce the negative effect of increasing group size on incentives for public goods provision. *Journal of Economic Psychology*, in press.

Sääksvuori, L., Mappes, T., & Puurtinen, M. (2011). Costly punishment prevails in intergroup conflict. *Proceedings of the Royal Society of London B: Biological Sciences*, rspb20110252.

San Román, T. (1986). *Entre la marginación y el racismo. Reflexiones sobre la vida de los gitanos*. Madrid: Alianza Universidad.

San Román, T. (2010). *La diferencia inquietante: viejas y nuevas estrategias culturales de los gitanos*. Siglo XXI de España Editores

Schiller, B., Baumgartner, T., & Knoch, D. (2014). Intergroup bias in third-party punishment stems from both ingroup favoritism and outgroup discrimination. *Evolution and Human Behavior*, *35*(3), 169-175.

Sell, A., Tooby, J., & Cosmides, L. (2009). Formidability and the logic of human anger. *Proceedings of the National Academy of Sciences*, *106*(35), 15073-15078.

Shelton, J. N. (2003). Interpersonal concerns in social encounters between majority and minority group members. *Group Processes & Intergroup Relations*, *6*(2), 171-185.

Shinada, M., Yamagishi, T., & Ohmura, Y. (2004). False friends are worse than bitter enemies:“Altruistic” punishment of in-group members. *Evolution and Human Behavior*, *25*(6), 379-393.

Sigmund, K. (2007). Punish or perish? Retaliation and collaboration among humans. *Trends in Ecology & Evolution*, *22*(11), 593-600.

Soltis, J., Boyd, R., & Richerson, P. J. (1995). Can group-functional behaviors evolve by cultural group selection?: An empirical test. *Current Anthropology*, *36*(3), 473-494.

Sorescu-Marinković, A. (2013). "The court of the Bayash: Revising a theory." *Romani Studies 23*(1), 1-28.

Tabibnia, G., & Lieberman, M. D. (2007). Fairness and cooperation are rewarding. *Annals of the New York Academy of Sciences*, *1118*(1), 90-101.

Tabibnia, G., Satpute, A. B., & Lieberman, M. D. (2008). The sunny side of fairness preference for fairness activates reward circuitry (and disregarding unfairness activates self-control circuitry). *Psychological Science*, *19*(4), 339-347.

Tajfel, H. (1974). Social identity and intergroup behaviour. *Social Science Information/sur les Sciences Socials*, *13*(2), 65-93.

Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. *The Social Psychology of Intergroup Relations*. Monterey, CA: Brooks/Cole.

Tooby, J., & Cosmides, L. (1990). The past explains the present: Emotional adaptations and the structure of ancestral environments. *Ethology and sociobiology*, *11*(4), 375-424.

Trivers, R. L. (1971). The evolution of reciprocal altruism. *Quarterly Review of Biology*, 46(1), 35-57.

Tropp, L. R., & Pettigrew, T. F. (2005). Relationships between intergroup contact and prejudice among minority and majority status groups. *Psychological Science*, *16*(12), 951-957.

Van Vugt, M., De Cremer, D., & Janssen, D. P. (2007). Gender differences in cooperation and competition the Male-Warrior hypothesis. *Psychological Science*, *18*(1), 19-23.

Walker, R. S. (2014). Amazonian horticulturalists live in larger, more related groups than hunter–gatherers. *Evolution and Human Behavior*, *35*(5), 384-388.

Walker, R. S., & Bailey, D. H. (2014). Marrying kin in small-scale societies. *American Journal of Human Biology*, *26*(3), 384-388.

Weyrauch, W. O. (Ed.) (2001). *Gypsy law: Romani legal traditions and culture*. University of California Press.

Yamagishi, T. (1986). The provision of a sanctioning system as a public good. *Journal of Personality and social Psychology*, *51*(1), 110.

Capítulo 3:
The appropriate response of Spanish *Gitanos*: Short-run orientation beyond current socio-economic status

3 The appropriate response of Spanish *Gitanos*: Short-run orientation beyond current socio-economic status[6]

Abstract

Humans differ greatly in their tendency to discount future events, but the reasons underlying such inter-individual differences remain poorly understood. Based on the evolutionary framework of Life History Theory, influential models predict that the extent to which individuals discount the future should be influenced by socio-ecological factors such as mortality risk, environmental predictability and resource scarcity. However, little empirical work has been conducted to compare the discounting behavior of human groups facing different socio-ecological conditions. In a lab-in-the-field economic experiment, we compared the delay discounting of a sample of Romani people from Southern Spain (*Gitanos*) with that of their non-Romani neighbors (i.e., the majority Spanish population). The Romani-*Gitano* population constitutes the main ethnic minority in all of Europe today and is characterized by lower socio-economic status (SES), lower life expectancy and poorer health than the majority, along with a historical experience of discrimination and persecution. According to those Life History Theory models, *Gitanos* will tend to adopt "faster" life history strategies (e.g., earlier marriage and reproduction) as an adaptation to such ecological conditions and, therefore, should discount the future more heavily than the majority. Our results support this prediction, even after controlling for the individuals' current SES (income and education). Moreover, group-level differences explain a large share of the individual-level differences. Our data suggest that human inter-group discrimination might shape group members' time preferences through its impact on the environmental harshness and unpredictability conditions they face.

[6] This paper has been published as Martín, J., Brañas-Garza, P., Espín, A. M., Gamella, J. F., & Herrmann, B. (2019). The appropriate response of Spanish *Gitanos*: Short-run orientation beyond current socio-economic status. *Evolution and Human Behavior*, *40*(1), 12-22.

3.1 Introduction

In nature, individuals of different species often have to choose between outcomes realized at different times (Ainslie 1975, Rachlin & Green, 1972). These inter-temporal choices are also ubiquitous in the lives of humans, for instance, in the spheres of marriage and reproduction, education and work, as well as during social and market interactions (Espín et al. 2012, 2015, Frederick et al. 2002, Nettle et al. 2011, Woodburn 1980). When faced with such decisions, individuals tend to discount the value of delayed rewards. The preference for sooner-smaller rewards over later-larger rewards has been referred to as delay discounting (DD) (Frederick et al. 2002, Kirby et al. 2002). DD is considered to be a measure of one of the multiple domains of impulsivity, namely "impulsive choice" (Bevilacqua & Goldman 2013, Reynolds et al. 2006).

DD tends to be a stable individual characteristic (Ohmura et al. 2006, Kirby 2009) – although it may be momentarily influenced by short-term state manipulations (e.g., Kidd et al. 2013, Read & van Leeuwen 1998) – and people differ greatly in the extent to which they discount the future (Frederick et al. 2002). However, the factors underlying such inter-individual differences remain poorly understood. On the one hand, there is evidence suggesting that DD rates are heritable to some extent (Anokhin et al. 2011, 2015, Aycinena & Rentschler 2017, Bevilacqua & Goldman 2013). On the other hand, people's current socio-economic conditions, as proxied by variables such as education and income, also seem to be related to DD: poorer and less educated individuals have been found to discount the future more heavily (Harrison et al. 2002, Kirby et al. 2002, Tanaka et al. 2010), although the causal direction is unclear (Becker & Mulligan 1997). In addition, a number of behavioral disorders (e.g., attention-deficit/hyperactivity disorder, aggression, suicide, and substance abuse) have been associated with high DD (Barkley et al. 2001, Bickel & Marsch 2001, Dombrovski et al. 2011).

The latter evidence has been taken to support the notion of high DD as a maladaptive trait. However, under certain socio-ecological conditions, discounting the future can be a contextually appropriate response. To be more specific, developing a preference for the short-run may be fitness-maximizing in harsh and unpredictable environments (Becker & Mulligan 1997, Daly & Wilson 2005, Frankenhuis et al. 2016, Hill et al. 2008, Pepper & Nettle 2017).

According to Life History Theory (del Giudice et al. 2015, Kaplan & Gangestad, 2005, Roff 1993), variation in life history traits (e.g., size and number of offspring, parental investment, longevity, time to first reproduction, sociability) can be understood in terms of trade-offs in the allocation of resources to competing life functions such as maintenance, growth, and reproduction. The accumulated set of resource allocation decisions during life constitutes the individual's life history strategy, which leads to the development of an integrated collection of life history traits. The most common approach to life history strategies poses a continuum from slow to fast (Promislow & Harvey 1990). Leading models based on Life History Theory rely on this slow-to-fast approach to predict variation of traits and strategies both between and within species. In this vein, unpredictable and harsh environments are particularly related to the development of fast life history strategies that divert resources from long-term outcomes in favor of short-term outcomes, while predictable and secure settings lead to strategies in the opposite, slow end of the continuum (Kaplan & Gangestad,2005).

Life history strategies are often seen as species-distinctive characteristics but humans (as well as other organisms) have evolved mechanisms of phenotypic plasticity that allow them to adjust life history strategies to match local conditions during their lifetime (Belsky et al. 1991, Brumbach et al. 2009, Ellis 2004, McCullough et al. 2013, Nettle et al. 2010, 2011, Worthman 2003). These strategies would lead to the maximization of individuals' average lifetime inclusive fitness (del Giudice et al. 2015, Kaplan & Gangestad 2005, Roff 1993). However, it is worth noting that existing theories are almost entirely based on verbal models, or on formal models designed to study the evolution of variation in life history strategies between species/populations, which tend to ignore the plasticity in life history strategies within species/populations.[7] Few formal models to date have examined how suits of traits (e.g., onset of puberty, number of offspring, investment per offspring) should covary as a result of phenotypic plasticity (e.g., along a fast-slow continuum), depending on environmental conditions (Mathot & Frankenhuis 2018). For pioneering verbal models of within-species/populations variation in life history traits along the fast-slow continuum, see Belsky et al. (1991), Ellis et al. (2009) and Reale et al. (2010).

[7] We thank Reviewer 1 for pointing out this important issue.

Yet, although the theoretical literature on life history clearly stresses the role of environmental conditions in shaping individuals' DD, more research needs to be conducted to assess this link empirically. While a number of individual-level studies provide support for the hypothesized relationships by showing, for example, a connection between high DD and variables such as low income and education, which can be considered as proxies for unfavorable (potentially harsh and/or unpredictable) conditions (Becker & Mulligan 1997, Chipman & Morrison 2015, Green et al. 1996, Griskevicius et al. 2011, Kirby et al. 2002, Pender 1996), few studies to date have examined to what extent the conditions of harshness and future-unpredictability faced by different groups can predict individual differences in DD. Given that those individual-level studies do not use grouping variables that are exogenous to the individual, they cannot put the focus on an environment-based analysis, as prevails in the theoretical literature. Ramos et al. (2013) is, to the best of our knowledge, the first study directly approaching the question. Consistent with the theoretical predictions, the authors show that slum-dwelling youth in Brazil (highly exposed to violence) discount future hypothetical rewards more heavily than university students from more affluent neighborhoods. A more recent study enlarged the number of comparison groups (46 countries were used as observation units) and found that country-level life expectancy can predict the average DD in a sample of university students from the country (Bulley & Pepper 2017), also as hypothesized by a life history approach. Finally, Lee et al. (2018) extended the latter analysis to a larger sample from 54 countries using individual-specific life expectancy (i.e., age-, sex-, year-, and country-specific life expectancy), and show that the theoretical relationship holds especially when waiting is arguably more beneficial, that is, when the later-larger reward is relatively high and delay is short. While these pieces of work have significant value, in the three cases, the authors compare groups of young individuals who, moreover, differ in a large number of uncontrolled characteristics that are not necessarily related to harsh and unpredictable living conditions but may influence DD. Among those are neighborhood facilities (which may translate into different access to services, for instance), geography, political regime, climate, and so forth. Furthermore, the tasks used to elicit the participants' time preferences (i) did not allow for a parametrization of the individuals' discount functions and (ii) were survey-based, without real incentives. In this paper we further contribute to fill this empirical gap.

To test the predictions of the evolutionary framework of Life History Theory, this study explores the differences in DD between two populations which often face different socio-ecological pressures even if they live in the same geographic areas, even in the same villages and neighborhoods. More specifically, using data from an economic experiment involving real monetary rewards, we compare the discounting behavior of a sample of Romani people from Southern Spain (*Gitanos* or *Calé*, as they typically refer to themselves) with that of their non-Romani neighbors (i.e., the majority Spanish population).[8] Technically speaking, we set up a quasi-experimental design where ethnicity is the only variable that a priori differs between treatment and control groups. Note that a pure experimental design cannot be applied here because the socio-ecological conditions under which the individuals develop, as proxied by their ethnicity, cannot be exogenously manipulated for obvious reasons. We consider that this design is as close to a controlled experiment as a study of these characteristics can be since ethnicity and its associated socio-ecological conditions are eminently exogenous, thus leaving little room for endogenous determination.

The localities where we conducted our experiments are characterized by a particularly high concentration of *Gitano* people, amounting to over 25% of the total population, compared to 1-1.5% in the whole of Spain (Gamella 1996, Gamella et al. 2014). However, the *Gitano* population is clearly differentiated in their demographic and cultural profile, and faces a markedly different socio-economic "ecology" than the majority. Hence it constitutes a paradigmatic ethnic group for the goal of this study. Notwithstanding this, it is worth noting that theoretically identical opportunities (Rawls 1971, Sen 1992) in terms of access to public education, social benefits and healthcare, are provided (at least legally, on paper) to the *Gitano* population, at least since the advent of democracy in Spain, four decades ago.

Compared to the dominant majority, the *Gitano* population of Spain is characterized by a lower socio-economic status (SES), including lower income and education, and also by poorer health, lower life expectancy and higher fertility rates (Casals et al. 2011, Cook et al. 2013, Gamella 2011, Gamella et al. 2014, La Parra Casado et al. 2016, MSC-FSG 2005). These processes have generated a differentiated demographic profile. For instance,

[8] Spanish *Gitanos* have been barely studied using experimental economics methods. We are only aware of two studies: Brañas-Garza et al. (2006) explores how *Gitanos* play the Ultimatum Game, while Espín et al. (2018) analyzes punishment in the Public Goods Game.

in the study area, the *Gitano* population had a mean age of 27 years compared to the near 42 of the overall local population (Gamella 2011). Life expectancy at birth has increased in this population almost continuously since the mid 1940s. But still today it seems to be from 5 to 10 years below that of their non-*Gitano* neighbors (Gamella 2011, MSC-FSG 2005). This may have resulted in a different set of aggregated needs and outlooks.

However, despite a long-lasting coexistence in many local areas, social exclusion, forced assimilation and discrimination by the majority have considerably influenced the lives of *Gitanos* as well as of other Romani groups in almost every part of the world (Matras 2015). In Spain this still affects the lives of *Gitano* people, particularly in the most segregated areas.

Several distinctive features of *Gitano* social life seem to reflect adaptations to these negative environmental and historical conditions. For instance, *Gitanos* maintain a strong and oppositional sense of identity and high levels of ethnic and familial endogamy. In the study area the *Gitano* minority presented rates of inbreeding five to eight times larger than those of the general population, and have maintained these until the present (Gamella & Martín 2007, Martín & Gamella 2005, Núñez Negrillo 2016). These endogamous strategies tend to increase their social and perhaps their genetic homogeneity (Bittles 2012). However they also might work as a protection against external threats associated with the discriminatory environments that *Gitano* confronted as a group (Fraser 1995, Gamella et al. 2013, Matras 2015). Interestingly, the rate of incarceration of *Gitanos* is still nowadays much higher than that of the majority population. As an example, in a number of recent studies, *Gitano* women accounted for over 25% of the female prison population, a huge over-representation (Cerezo 2016, Feintuch 2013).

In addition, most *Gitano* groups, as other Romani groups through Europe, also maintain patterns of early and pronatalist marriage. *Gitano* women in the study area were found to have a mean age of first childbirth of 18-19 years (over a decade earlier than the Spanish average), and total fertility rates that doubled and even tripled those of the Spanish population at large (Gamella 2011, Martín & Gamella 2005). Infant mortality rates displayed by *Gitanos* have declined sharply during the last 60 years but are still nowadays considerably larger (about 40%) than those observed in the non-*Gitano* population (Gamella & Martín 2017, Martín & Gamella 2005, MSC-FSG 2005).

These patterns of *Gitanos* can be understood as life history strategies situated at the (relatively) fast end of the fast-slow continuum, which are typically adopted by people who grow up in unpredictable and harsh environments (Brumbach et al. 2009, Dickins et al. 2012, Frankenhuis et al. 2016, Johns et al. 2011). When the future is uncertain or *predictably harsh* (Bulley et al. 2017, McGuire & Kable 2013), therefore, the appropriate response might be to develop a short time horizon (Becker & Mulligan 1997, Daly & Wilson 2005, Pepper & Nettle 2017) and to adopt strategies such as giving birth, as soon as possible, to the maximum number of offspring (Dickins et al. 2012, Johns et al. 2011, Nettle et al. 2011, Worthman 2003). In these ecologies, long-term resource allocation may not pay off because there is uncertainty (i.e. the distribution of outcomes has unknown properties such as the mean or SD due to random variation) that the organism will live until late adulthood. Although environmental harshness (risk of mortality-morbidity) and unpredictability (stochastic variation in salient environmental conditions which prevents ex-ante accurate predictions due to factors such as a lack of information or excessive complexity) are theoretically and empirically dissociable and may have differential effects on several life history traits (Belsky et al. 2012, Brumbach et al. 2009, Ellis et al. 2009), an orientation to the short-run is by definition predicted by both factors (Ellis et al. 2009, Frankenhuis et al. 2016, Roff 1993). In addition, the evidence suggests that the effects of environmental harshness and unpredictability on life history strategies are additive, not interactive (Brumbach et al. 2009). We further expand on this point in the Discussion section.

In this vein, the aforementioned models based on Life History Theory predict that *Gitanos* will tend to display higher DD rates than their non-Romani neighbors, due to the different ecologies faced. Moreover, it is expected that individual socio-economic factors such as current (at adult age) education and income account for some but not all of the difference because life-history-related behavioral traits such as temporal orientation are thought to be mainly shaped in earlier stages of development (e.g., Belsky et al. 1991, Griskevicius et al. 2011, McCullough et al. 2013, Mell et al. 2018). Group differences should indeed explain a large share of the individual differences, given the shared environmental influences during development within each group.

3.2 Methods

Protocol and participants

Five lab-in-the-field experimental sessions were conducted in five similar semi-rural towns in Southern Spain (see Espín et al. 2012 for more details). From a total of 160 participants, nine were excluded from the analyses due to missing information in some of the key variables of this study. The final sample thus consists of 151 participants (63.6% females). Among these, 64 are (self-)identified as *Gitanos*, whereas 87 belong to the majority, non-Romani population. Average age in our sample was 46.8 (range 17-82) years old. All the socio-demographic data were gathered in a post-experimental face-to-face interview, where age and years of schooling were obtained as continuous variables, while bins were used for income information ("no income (0€)", "less than 500€", "500€ or more but less than 1000€", and so on; see Table 1).

Table 1. *Descriptive statistics for the Gitano and majority samples*

	Gitanos					***Majority***				
Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Hyper-K	64	0.912	0.397	0.020	1.211	87	0.640	0.419	0.020	1.211
Exp-K	64	0.682	0.273	0.020	0.877	87	0.501	0.293	0.020	0.877
Gender (male)	64	0.469	0.503	0	1	87	0.287	0.455	0	1
Age	64	38.860	14.799	17	73	87	53.276	19.027	17	82
Regular income	64	0.250	0.436	0	1	87	0.483	0.503	0	1
Own income										
€0	64	0.297	0.460	0	1	87	0.322	0.469	0	1
(€0, €500)	64	0.516	0.504	0	1	87	0.126	0.334	0	1
[€500, €1000)	64	0.156	0.366	0	1	87	0.437	0.499	0	1
[€1000, €2000)	64	0.031	0.175	0	1	87	0.080	0.274	0	1
[€2000, €3000)	64	0	0	0	0	87	0.034	0.184	0	1
Other household's income										
€0	64	0.391	0.492	0	1	87	0.322	0.469	0	1
(€0, €500)	64	0.453	0.502	0	1	87	0.092	0.291	0	1
[€500, €1000)	64	0.109	0.315	0	1	87	0.276	0.450	0	1
[€1000, €2000)	64	0.047	0.213	0	1	87	0.172	0.380	0	1
[€2000, €3000)	64	0	0	0	0	87	0.103	0.306	0	1
≥€3000	64	0	0	0	0	87	0.034	0.184	0	1
Years schooling	64	2.906	3.022	0	6	87	6.632	4.232	0	15

Notes: Number of observations, mean, standard deviation, minimum value and maximum value for each of the variables used in the analyses, separately for the Gitano and majority samples. Note that the average educational level of our participants is rather low as compared to the country's official statistics due to the facts that (i) the experiments were conducted in a semi-rural and low-income area,

and (ii) that the participants were older than the average Spanish population (older adults are still nowadays less educated than younger ones in Spain, especially in rural and poor areas; see the strong negative correlation between age and years of schooling in Table 2).

We did not ask participants directly about their ethnicity. Instead we took advantage of researchers with extensive experience in the field to help us identify potential participants from both ethnic affiliations. In these villages, ethnicity is common knowledge and often verbalized – as was confirmed during the post-experimental interviews.

We have reported all the measures obtained and the experimental conditions that are relevant to the current study. Data exclusions are reported and justified below. The initial sample size (160 observations) was identical to Ramos et al. (2013) and allows us to obtain moderate differences (effect size, d=0.45) between the two groups with 80% power and α=0.05, accounting for representativeness in the relative sample sizes of the two groups (i.e., *Gitanos* represent between 1/5 and 2/5 of the towns' population).

Our procedure excluded two *Gitanos* from the sample for having missing income information and seven non-*Gitanos*, three for missing education achievement and four for missing income information. Except for three cases (one *Gitano* and two non-*Gitanos*) in which the participant did not know, or did not want to report, the income information, all missing values arise from interviewer's mistakes (failing to ask one of the questions). The later means that missing values can be considered random so that excluding those nine observations should not produce distortions. An alternative method based on the imputation of missing values to the sample average yields qualitatively similar results (see Text S3 in the Appendix).

The experimental sessions consisted of 32 participants each. The setting was nearly identical in each of the five towns. The Town Hall provided us with a large room, where we set up the "artefactual" lab consisting of a whiteboard, and 32 chairs and desks. Figure 1 shows one of the five assembled labs. As shown in Figure 1, cardboards were used to prevent visual contact between participants in order to ensure private decisions. Three of the authors plus a group of four assistants supervised all the sessions. The instructions were read aloud always by the same experienced researcher (see Text S1 in the Appendix).

Figure 1. *Representative "artefactual" lab. Location: Deifontes, Granada.*

Delay discounting task and measures

To measure the participants' DD, we employed a multiple-price-list task (Harrison et al. 2002) with a one-month front-end delay (Espín et al. 2012). Using a decision sheet (see Figure S1 in the Appendix), the task consisted of 20 decisions in which the participant had to choose between receiving €150 in one month time and receiving a higher amount (increasing from €151.50 to €225 across decisions) in seven months time by marking the preferred option with a cross. These increasing amounts to be received after seven months were also presented in terms of simple interest rates. The lowest amount in the seven-month option (i.e., €151.50) added €1.50 to the €150 of the one-month option, which entails an increase of 1% in six months, that is, an annual simple interest rate of 2%. The highest amount in the seven-month option (i.e., €225) added €75 to the €150 of the one-month option, which entails an increase of 50% in six months, that is, an annual simple interest rate of 100%. All participants were presented with same decisions in the same (ascending) order. The fact that both the sooner-smaller and the later-larger reward were delayed, so that there was no "today" option, allows capturing long-term discounting behavior and alleviates the effect of distrust (about the experimenters actually coming back to the town to pay participants) on decisions.

However, as detailed in the Discussion section, the use of this type of task entails some limitations that might influence our results.

In every session, one participant was randomly chosen to receive the real payment (on the specific date) associated with the participant's choice in one randomly-selected decision. Please refer to the Appendix (Text S1) for a more detailed explanation of the experimental procedure.

Delay discounting measures.

In the literature on DD there is considerable debate over which particular functional form better characterizes individuals' discounting (Andersen et al. 2014, Frederick et al. 2002). The most common measures of DD are based on either exponential (constant-discounting) or hyperbolic (decreasing-discounting) functional forms. For robustness, we test our hypothesis using both characterizations. In particular, we obtained a discounting parameter *K* for each individual using the following equations:

- For the hyperbolic functional form (henceforth *Hyper-K*)

$$V_d = \frac{V_u}{(1 + Kd)}$$

- For the exponential functional form (henceforth *Exp-K*)

$$V_d = V_u e^{-Kd}$$

Where V_d stands for the reward's discounted subjective value, V_u refers to its undiscounted value and d is the delay until its receipt (in years). The K parameter is derived from equalizing the discounted value of the sooner-smaller reward to that of the later-larger reward at the individual's indifference point between both rewards (see next subsection for an explanation of the different indifference points considered in the different analyses). The higher the *K*, the more heavily future rewards are discounted and thus the more short-run oriented the individual is.

The stability and external validity of DD measures have been evaluated in a number of previous studies. The test-retest stability of discount rates has been found to be in the range that is typically obtained for personality traits (Anokhin et al. 2015, Kirby 2009, Ohmura et al. 2006). While some null results exist (e.g., Eisenstein et al. 2015, Mejía-

Cruz et al. 2016, Stojek et al. 2014), evidence abounds that supports the validity of DD measures to predict behaviors with future consequences, such as addictions and drug consumption (Baker et al. 2003, Bickel & Marsch 2001, Yi et al. 2010), physical activity and obesity/overweight (Chabris et al. 2008, Reimers et al. 2009, Weller et al. 2008), and savings and loan use (Meier & Sprenger 2010, 2012, Sutter et al. 2013).

Statistical analysis

We first report descriptive statistics for all the variables analyzed, separately for the *Gitano* and majority samples, in Table 1. Zero-order Spearman's correlations between all the variables are presented in Table 2. Since the variables used in these initial analyses are categorical and/or arguably not normally distributed, parametric methods such as t-test or Pearson's correlation are not justified, and thus we stick to non-parametric analysis. Although for some secondary analyses other approaches such as Fisher's exact or Mann-Whitney tests tend to be more suitable, in the main text we report only correlations (Table 2) for the sake of brevity and, when appropriate, refer to the p-values from those other tests, which are developed in more detail in Text S2 in the Appendix.

Table 2. *Bivariate Zero-Order Correlations*

	DD	Ethnicity (*Gitano*)	Gender (male)	Age	Regular income	Own income	Other h's income
Ethnicity (*Gitano*)	0.3172*** 0.0001	-					
Gender (male)	0.0039 0.9625	0.1863** 0.0220	-				
Age	-0.0868 0.2895	-0.3838*** 0.0000	-0.0616 0.4525	-			
Regular income	-0.1118 0.1716	-0.2365*** 0.0035	0.2228*** 0.0060	0.3314*** 0.0000	-		
Own income	-0.1602** 0.0494	-0.2161*** 0.0077	0.2781*** 0.0005	0.3222*** 0.0001	0.6676*** 0.0000	-	
Other household's income	-0.1581* 0.0524	-0.3082*** 0.0001	-0.1727** 0.0339	-0.2532*** 0.0017	-0.1306 0.1100	-0.1799** 0.0271	-
Years Schooling	-0.1506* 0.0649	-0.4194*** 0.0000	0.0540 0.5103	-0.3831*** 0.0000	0.0387 0.6373	0.0282 0.7309	0.3282*** 0.0000

Notes: Spearman's rho coefficients and p-values. *Ethnicity*, *Gender* and *Regular income* are dummy variables taking the value of one if the participant is *Gitano*, male and has a regular income source, respectively; zero otherwise. *Own income* and *Other household's income* are coded as ordered discrete variables. Since these are rank-order correlations, the measure of DD here is merely given by the number of sooner-smaller choices in the task, which is independent from the functional form used to characterize DD. * p<0.1, ** p<0.05, *** p<0.01, two-tailed.

In Figure 2, we visually compare the DD of *Gitanos* with that of the majority employing different approaches (comparing cumulative distribution functions and subgroups in terms of age and income). For all these analyses, we consider that the smallest amount at which an individual is willing to wait the six months longer (i.e., seven months instead of one) represents her indifference point between the sooner-smaller and the later-larger reward (as in Espín et al. 2012).

For the second and main analysis, we estimated individuals' *K* parameters using interval regressions (Harrison et al. 2002). In this set of regressions, the indifference point of an individual is estimated to be in the interval between the later-larger amount offered in the decision immediately before the individual switched from the sooner-smaller to the later-larger reward and that offered in the switching decision (for those individuals who never switched, the interval is assumed to be open; note that participants were specifically instructed not to follow multiple-switching, inconsistent patterns, as explained in more detail in Text S1). The interval regression method, thus, does not force us to assume an arbitrary, fixed indifference point (for instance, at the midpoint or the upper/lower bound) within each interval since it is instead estimated from the participants' choices. This exercise cannot be done with other estimation methods such as ANOVA, OLS or Tobit. The regression analysis also allows us to control for key individual variables which could mediate a potential difference in DD between *Gitanos* and the majority.

All the analyses were conducted using Stata v12 (StataCorp, Texas, USA). Unless otherwise stated, reported p-values were calculated from two-tailed tests.

Ethics statement

All participants provided consent prior to participation. Oral informed consent was obtained because literacy was not a requirement to participate due to the (expected) low educational level of many participants; only being able to read and write numbers was required to participate. This study was conducted in accordance with the Declaration of Helsinki for human research. All participants were treated anonymously by assigning them a numerical code in accordance with the Spanish Law 15/1999 on Personal Data Protection.

3.3 Results

Regarding demographic differences between the *Gitano* and majority samples, the former were younger and more likely to be males (see Table 1; both ps<0.03 according to Mann-Whitney and Fisher's exact test, respectively, Text S2). For current SES, we observe that *Gitanos* were less likely to have a regular monthly income source, and reported a lower monthly income (both own income and other household's income) and a lower number of years of schooling, compared to the majority (all ps<0.01, see Table 1 and Text S2). These differences are an indication of the representativeness of our *Gitano* and majority samples but also reflect the necessity of controlling for these variables in a regression analysis.

In panel A of Figure 2, a stochastic dominance approach is used to compare the responses of the two ethnic groups in the DD task. In panels B and C, respectively, we display the mean *Hyper-K* and *Exp-K* of the two groups for each age tercile (note that we split age into terciles for visual clarity in the figure as it is the minimal split to observe potential non-linear relationships; all statistical analyses were performed using age as a continuous variable, though). Finally, in panels D and E, we perform the same comparison but now the sample is split into below-median and above-median total household income (given by the combination of own income and other household's income).

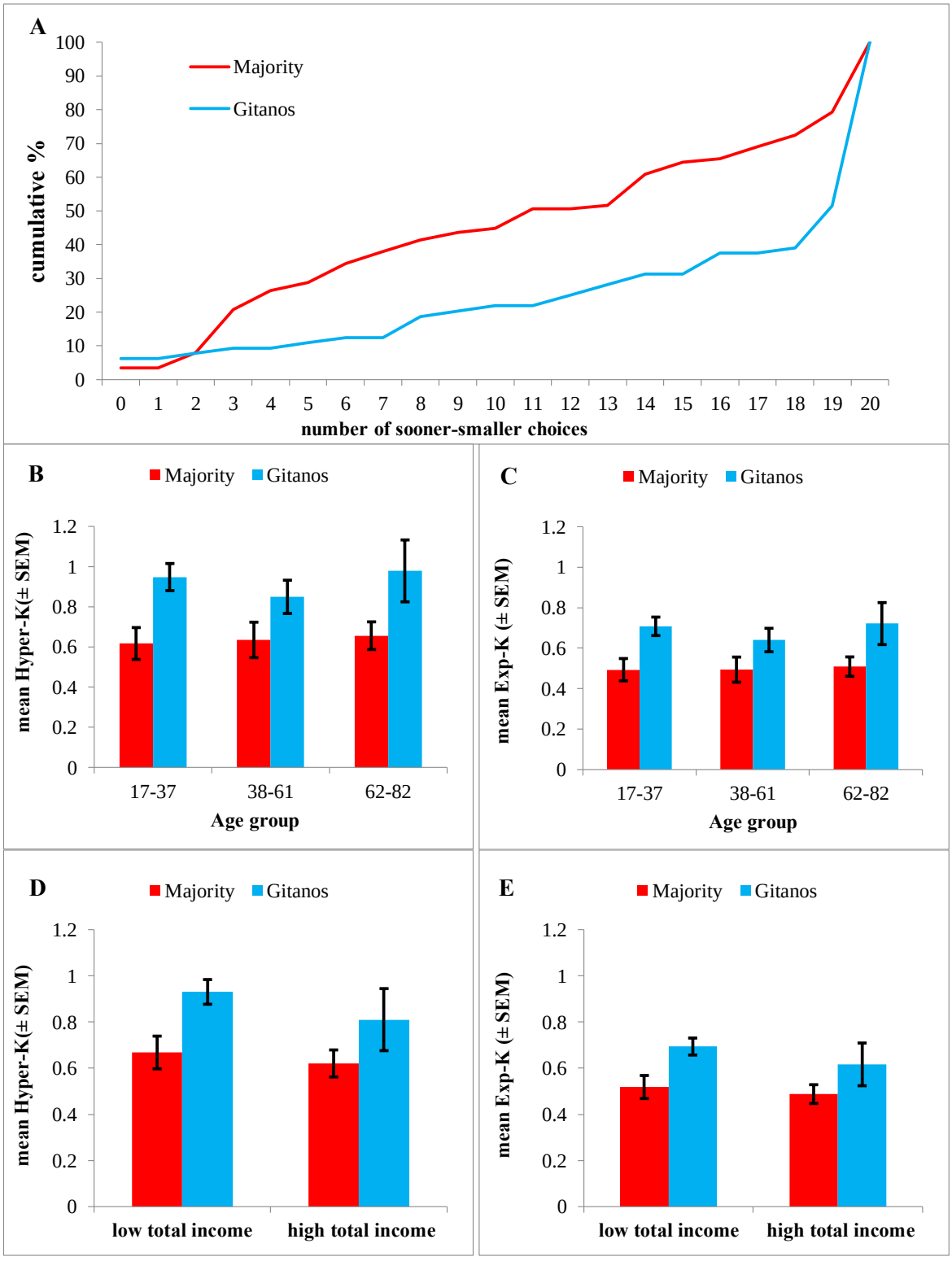


Figure 2. *Comparison of DD between the Gitano and the majority samples. Stochastic dominance analysis (panel A); mean Hyper-K and Exp-K for each age tercile (panels B and C); mean Hyper-K and Exp-K for below- and above-median total household income (panels D and E).*

We observe that, on average, *Gitanos* discount the future more heavily than the majority (mean differences of 0.272 and 0.181 for *Hyper-K* and *Exp-K*, respectively; see Table 1). For both characterizations of *K*, the raw (without controls) difference between *Gitanos* and the majority is significant according to Mann-Whitney test ($p<0.01$, Text S2) and interval regression ($ps<0.01$, Table 3, model 1). Similarly, as shown in panel A of Figure 2, the DD of the majority is stochastically dominated by that of *Gitanos*. More specifically, strict dominance is observed for all values (number of sooner-smaller choices) higher than two. From Figure 2A we can also see that our DD measure is strongly right-censored, especially for *Gitanos* (48% and 21% of the *Gitano* and majority individuals, respectively, chose the sooner-smaller option in every decision), which implies that reported differences will tend to underestimate the true underlying effect.

Table 3. *Interval regression estimation of individuals' DD (K)*

	1a	1b	2a	2b	3a	3b	4a	4b
dep. var.:	*Hyper-K*	*Exp-K*	*Hyper-K*	*Exp-K*	*Hyper-K*	*Exp-K*	*Hyper-K*	*Exp-K*
Ethnicity (*Gitano*)	0.375***	0.264***	0.444***	0.311***	0.403***	0.280***	0.399**	0.277**
	(0.097)	(0.069)	(0.105)	(0.075)	(0.123)	(0.087)	(0.176)	(0.125)
Gender (male)			-0.091	-0.069	-0.037	-0.030	-0.041	-0.031
			(0.104)	(0.074)	(0.106)	(0.076)	(0.122)	(0.087)
Age			-0.024	-0.017	-0.021	-0.016	-0.021	-0.015
			(0.016)	(0.011)	(0.015)	(0.011)	(0.016)	(0.011)
Age^2			0.027	0.020	0.025	0.018	0.025	0.018
			(0.018)	(0.013)	(0.017)	(0.012)	(0.017)	(0.012)
Regular Income					0.034	0.023	0.023	0.016
					(0.145)	(0.104)	(0.145)	(0.104)
own income (€0, €500)					-0.070	-0.051	-0.083	-0.059
					(0.140)	(0.099)	(0.146)	(0.103)
own income [€500, €1000)					-0.156	-0.114	-0.158	-0.116
					(0.163)	(0.116)	(0.163)	(0.116)
own income [€1000, €2000)					-0.061	-0.038	-0.109	-0.073
					(0.208)	(0.147)	(0.220)	(0.155)
own income [€2000, €3000)					-0.634**	-0.467**	-0.625*	-0.456*
					(0.287)	(0.213)	(0.324)	(0.240)
other household's income (€0, €500)							0.024	0.012
							(0.138)	(0.098)
other household's income [€500, €1000)							-0.045	-0.036
							(0.143)	(0.102)
other household's income [€1000, €2000)							-0.109	-0.075
							(0.154)	(0.109)
other household's income [€2000, €3000)							-0.176	-0.131
							(0.225)	(0.160)
other household's income ≥€3000							-0.103	-0.078
							(0.226)	(0.159)
Years schooling							0.012	0.008
							(0.018)	(0.013)
Constant	0.648***	0.510***	1.079***	0.833***	1.089***	0.840***	1.059**	0.824***
	(0.058)	(0.041)	(0.324)	(0.229)	(0.314)	(0.222)	(0.431)	(0.304)
ln sigma Cons.	-0.607***	-0.945***	-0.618***	-0.956***	-0.632***	-0.971***	-0.638***	-0.978***
	(0.075)	(0.077)	(0.073)	(0.075)	(0.073)	(0.075)	(0.074)	(0.075)
chi^2	14.910***	14.516***	19.180***	18.757***	28.613***	27.437***	34.569***	34.463***
ll	-395.167	-390.9827	-393.4772	-389.2568	-391.6776	-387.3093	-391.1013	-386.7487
Pseudo-R^2	0.094	0.091	0.114	0.112	0.135	0.134	0.141	0.141
N	151	151	151	151	151	151	151	151

Notes: Interval regression estimates. Model 1 tests the effect of ethnicity on DD without control variables. In model 2, demographic controls are included (Age^2 refers to $Age^2/100$). Whether the individual has a regular income source and the individual's own monthly income (omitted category: €0) are also controlled for in model 3. Finally, model 4 also controls for other household's income (omitted category: €0) and years of schooling. For each model specification, *Hyper-K* and *Exp-K* are the dependent variable in column (a) and (b), respectively. Robust standard errors in parentheses. Pseudo-R^2 refers to Cox-Snell's index. * p<0.1, ** p<0.05, *** p<0.01, two-tailed.

However, as mentioned, *Gitanos* differ from the majority according to all the variables which will serve as individual-level controls. More importantly, some of these variables are also correlated with DD, in particular those used as proxies for current SES: income (both one's own and household's income) and years of schooling are negatively related with DD, although in some cases the correlation is only marginally significant (ps<0.07, Table 2). Therefore, the aforementioned ethnic differences in DD might actually be driven by individual socio-economic factors.

After controlling for these potential individual-level confounds, however, *Gitanos* still display higher discount rates than the majority according to both DD characterizations (ps<0.03, models 2-4 in Table 3; see also panels B-E in Figure 2). Comparing model 1 with models 2-4 in Table 3, we observe that the addition of control variables does not substantially reduce the coefficient of ethnicity. Furthermore, among the control variables, only the highest category of own income (*€2000-€3000*) remains significant or marginally significant when ethnicity is taken into account (ps<0.06); although as can be seen in Table 1 there are non-*Gitanos* in this category, so this result is arguably trivial. Both education and household's income become non-significant (ps>0.40). Thus, it is the group-level differences that appear to explain a large portion of the individual-level differences, not the opposite. While our interval regressions do not allow us to compare the partial variance explained by each explanatory variable, an approximation using hierarchical OLS regressions (assuming known indifference points as for the previous secondary analyses, see the Statistical Analysis section) yields useful insights. On the one hand, if entered first, ethnicity explains 9.8% and 9.1% of the variance of *Hyper-K* and *Exp-K*, respectively (both ps<0.01), and adding current SES (income and education variables) increases R^2 by 2.6% and 2.8%, respectively. The explanatory power added by current SES is non-significant, however (both ps>0.33). On the other hand, if entered first, current SES explains 7.7% and 7.6% of the variance of *Hyper-K* and *Exp-K*, respectively (both ps<0.01), and adding ethnicity increases R^2 by 4.7% and 4.3%, respectively. The explanatory power added by ethnicity is significant (both ps<0.01).

Finally, another prediction of an adaptationist approach to DD is that age will show a U-shaped relationship with *K*: both young and old individuals must discount the future more heavily than middle-aged individuals (Becker & Mulligan 1997, Read & Read

2004) because external hazards are perceived to be higher at younger ages (i.e., young people do not yet know if their world is risky or safe) whereas the true risk of death increases with age (Sozou & Seymour 2003). We indeed observe a slight U-shaped relationship between age and *K*, in particular among *Gitanos* (see panels B and C in Figure 2), with a minimum *K* at about 44 yr. according to the regression estimates (see models 2-4 in Table 3), similarly to (Read & Read 2004). Yet, the coefficients of age and age squared would become only close to significance even using one-tailed hypothesis testing (which is justified if the U-shape hypothesis is considered directional; ps<0.20 and ps<0.10 for two- and one-tailed tests, respectively).

3.4 Discussion

These results contribute to the scarce empirical literature on group-level differences in discounting behavior. Our data supports the adaptationist arguments of leading models built upon Life History Theory (e.g., Ellis et al. 2009, Frankenhuis et al. 2016, Kaplan & Gangestad 2005). That is, participants from the ethnic group which faces harsher and more unpredictable ecological conditions discount the future more heavily even after controlling for the individuals' current SES. Those adaptationist arguments applied to our results would entail that *Gitanos* discount the future heavily due to environmental uncontrollable factors which turn a preference for the present to be contextually appropriate, at least at the developmental time when this trait is established. Moreover, current SES loses nearly all its explanatory power once ethnicity is taken into account (although it is true that our current SES measures could not cover the whole spectrum of SES-related variables and there might be not enough variability, especially among *Gitanos*). This may ultimately imply that some fraction of the previously-reported relationship between socio-economic variables and DD (Harrison et al. 2002, Kirby et al. 2002, Read & Read 2004, Tanaka et al. 2010) could be driven by unobserved factors related to the ecological conditions under which individuals developed, rather than by the individuals' current SES.

Recent research shows that individuals from small-scale societies with immediate-return systems display higher DD rates than individuals from agricultural societies in which resource accumulation is more pervasive (Salali & Migliano 2015). The authors argue that in egalitarian immediate-return economic systems, discounting the future may

be a group-level adaptive strategy to the extent that it prevents resource accumulation and, consequently, the formation of hierarchies which could threat within-group equality (Salali & Migliano 2015, Woodburn 1982). More research is required, however, to determine whether the existence of group-level selective pressures is a necessary prerequisite for the emergence of this kind of inter-group behavioral differences.

In sum, further empirical research should systematically assess the extent to which inter-individual differences in DD can be better characterized as inter-group differences. Ours is only a first step in this direction which must be complemented with data from a larger number of ethnic groups before being able to draw firmer conclusions. The study of only two ethnic groups which differ in a number of current and historical ecological factors (such as life expectancy, health and socio-economic status, discrimination and persecution rates) prevents a systematic dissection of the partial effects of each one of these group-level differences on DD. A recent study using survey data from more than 40 countries finds that the proportion of "impatient citizens" (i.e., those who chose the sooner-smaller reward in a single hypothetical survey question) in a country is negatively related to the country's average life expectancy (this result has been replicated by Lee et al. 2018 using a different approach), and that adding life expectancy to the equation eliminates the negative country-level relationship between impatience and age at first birth (Bulley & Pepper 2017). The latter results, although not directly addressing causality due to the cross-sectional nature of the data, suggest that it is environmental mortality cues (as proxied by life expectancy) that influence both short-run orientation and early-reproduction decisions.

With the present data, causality cannot be assessed either and many questions remain unanswered. For instance, future research should try to elucidate which part of the inter-ethnic differences in DD might be understood as reflecting group-level (culturally transmitted) adaptations rather than individual-level adaptations to group-level conditions (Cavalli-Sforza & Feldman 1981, Lumsden & Wilson 1981, McElreath et al. 2003). Life history traits may be acquired through cultural transmission (Boyd & Richerson 1988, Lumsden & Wilson 1981). In our case, the historical common experience of discrimination and persecution of the *Gitano* population, which are nowadays much reduced as compared to past centuries, is an obvious candidate to represent a cultural influence on the *Gitanos*' discounting behavior. Only the study of a larger number ethnic

groups with varying group-level differences (in terms of both current and historical socio-ecological conditions), however, can effectively tackle this question. Yet, such an exercise would unavoidably lead to loss of experimental control since the inclusion of a larger number of ethnic groups, to the extent that they do not live in the exact same place, implies that many confounding factors are at play, such as geography, natural resource availability, weather, and political regime.

Finally, our method to measure DD imposes several limitations that merit consideration. Although we focus on the differences between groups rather than on the exact estimated discount rates of participants, with the type of DD task we use, the elicited discount rates may be confounded by a series of factors. First, note that if *Gitanos* were less able than the majority to access and exploit the capital market (which seems reasonable), this might translate into higher estimated discount rates which are not related to pure time preference but to the (im)possibility of intertemporal arbitrage (Frederick et al, 2002). Although we consider that the relatively small monetary rewards offered in the task are not treated by subjects as susceptible for market arbitrage, and we also control for a number of income-related variables, whether this factor can explain part of the difference between *Gitanos* and the majority is an interesting endeavor for future research. Second, another possible confound relates to the concavity of the utility function. Our method assumes that individuals' utility functions are approximately linear over the range of stakes involved (this is common in the experimental literature on DD). However, a more concave utility function can be confounded with a higher discount rate (Andersen et al., 2008, Frederick et al, 2002, Lopez-Guzman et al., 2018). In this vein, our results could also be partially explained if *Gitanos* have a more concave utility function compared to the majority. Yet, this would mean that *Gitanos* are more risk averse since individual risk aversion is measured by the concavity of the utility function. Such an argument, while possible, is difficult to sustain given the evidence reviewed earlier (for instance, on incarceration rates).

Third, the preference for sooner-smaller rewards over later-larger ones might be due to uncertainty about the future (Frederick et al 2002). If any subject feels that the later reward will probably not be delivered then she can take the sooner reward in order to avoid the uncertainty. Therefore, she may appear as impatient while she is not. To alleviate this concern, we used a front-end delay methodology (Harrison et al. 2002) in

which both the sooner and the later reward are delayed: the sooner reward is delayed by one month and the later by seven months. Hence, if there is uncertainty/distrust about future payments then both choices will be equally dubious. Note that if the sooner payment is immediate (instead of delayed) – as e.g. in Anokhin et al. (2011), Barkley et al. (2001), Dombrovski et al. (2011), Kirby et al. (2002) – then the respondent may choose it to reduce uncertainty instead of due to pure time preferences. Therefore our results might be explained by uncertainty only if *Gitanos* perceive the future (not the delayed payments in the task per se) as more uncertain than the majority. This is exactly what our paper argues: since the environment of *Gitanos* is harsher and the future is more uncertain for them, they are more focused on the short-run than the majority.

Fourth, a higher expectation of future inflation may lead an individual to prefer sooner-smaller rewards without the influence of time preference, simply because the money is worth less in the future (Frederick et al 2002). If this confound explains part of our results, it would mean that *Gitanos* expect higher inflation than non-*Gitanos*. In principle, we consider this to be counterintuitive since *Gitanos* should instead be potentially assumed to care less about the possibility of inflation due to their poorer knowledge of economic dynamics – i.e. they should be more, not less, affected by "money illusion". Even assuming that *Gitanos* expect higher inflation than non-*Gitanos* (due to any unobserved differential experience they might have), it is worth noting that the DD differences between the two groups are remarkable. To explain the current results in absence of time preferences, *Gitanos* should expect a differential inflation >25% than the majority. However, the maximum inflation rate that Spain has experienced in the last 30 years was about 7%, with an average of about 3%. Thus, it sounds sensible to conclude that different expectations of inflation do not crucially drive our results.

Fifth, if someone believes she will be richer in the future, she might associate a lower relative value to the future rewards – and thus look as more impatient - without any true effect of time preference (Frederick et al, 2002). Applied to our results, this would mean that *Gitanos* expect to be relatively richer in seven months (vs. one month) compared to non-Gitanos. In order to test the validity of this concern, we compared the DD of the two groups only for those individuals who have a regular monthly income source. People with regular income are expected to exhibit more homogeneous beliefs about their future wealth than those individuals with irregular income sources. Thus, if

this confound is partially driving our results, we would expect that the DD differences between the two groups would be reduced for the subsample of subjects with regular income. However, among those with regular monthly income (n=58), the difference in estimated exponential discount rate between *Gitanos* and the majority is about 0.50 ($p<0.01$; controlling for demographic variables) while among those with more irregular incomes (n=93) the difference is about 0.30 ($p<0.02$). Therefore, we conclude that this result does not support the hypothesis of expectations of changing utility. In any case, please note that the gap between the two options is only 6 months, short enough to avoid large changes in expected wealth.

In sum, our results suggest that discounting the future heavily might be a contextually appropriate response under the environmental conditions faced by *Gitanos*. A preference for the short-run could thus be developed as an adaptive response to uncertain and harsh ecologies, which talks against the view of impatience as dysfunctional, even if it may yield undesirable outcomes such as drug consumption and other unhealthy behaviors. The latter, however, opens the door for reverse or bi-directional causality in the sense that high DD may trigger morbidity and lower life expectancy. One potential source of reverse causality is genetics: if DD is heritable (Anokhin et al. 2011, 2015, Aycinena & Rentschler 2017, Bevilacqua & Goldman 2013), a negative relationship between life expectancy and impatience (Bulley & Pepper 2017, Lee et al. 2018), for instance, might be led by genetic variation rather than life history calibrations (see Zietsch, 2016 for a discussion).[9] Regarding the current results, it might seem plausible that genetic differences between *Gitanos* and non-*Gitanos* help explain the DD differences. Since inbreeding and endogamy should have increased genetic homogeneity/isolation among *Gitanos* (Cavalli-Sforza et al. 2004, Kalaydjieva et al. 2001, 2005), it follows that if genetic variation drives behavioral variation, *Gitanos*' DD should display lower variance than that of the majority. Yet, variance tests cannot reject the hypothesis that behavioral heterogeneity is the same in the two groups. Indeed, even if *Gitanos* exhibit slightly lower variance in DD (0.40 vs. 0.42 for *Hyper-K* and 0.27 vs. 0.29 for *Exp-K*), the difference is largely insignificant (both $ps>0.55$, two-tailed). Moreover, recall that *Gitanos* were more likely to choose the sooner-smaller reward in every decision (48% and 21% of the *Gitano* and majority individuals, respectively, chose

[9] We thank Reviewer 2 for suggesting us this discussion.

the sooner-smaller option in every decision; see Figure 2A). This fact, arising from the task design, arguably increases the relative behavioral homogeneity among *Gitanos* artificially. The same variance tests conducted excluding those individuals still do not yield significance but show that variation is even slightly higher among *Gitanos* (0.38 vs. 0.34 for *Hyper-K* and 0.27 vs. 0.25 for *Exp-K*; both ps>0.44). These results, therefore, do not favor a gene-based explanation of the between-groups DD differences.

Further research should systematically unpack the relative influences that each one of the specific environmental factors defining individuals' living ecologies have on discounting behavior. In particular, our data indicate that the formation of individuals' time preferences might be importantly shaped by group-level social factors such as discrimination and segregation through their direct impact on environmental harshness and unpredictability.

References

Ainslie, G. (1975). Specious reward: a behavioral theory of impulsiveness and impulse control. *Psychological Bulletin*, *82*(4), 463.

Andersen, S., Harrison, G. W., Lau, M. I., & Rutström, E. E. (2008). Eliciting risk and time preferences. *Econometrica*, *76*(3), 583-618.

Andersen, S., Harrison, G. W., Lau, M. I., & Rutström, E. E. (2014). Discounting behavior: A reconsideration. *European Economic Review*, *71*, 15-33.

Anokhin, A. P., Golosheykin, S., Grant, J. D., & Heath, A. C. (2011). Heritability of delay discounting in adolescence: a longitudinal twin study. *Behavior Genetics*, *41*(2), 175-183.

Anokhin, A. P., Grant, J. D., Mulligan, R. C., & Heath, A. C. (2015). The genetics of impulsivity: evidence for the heritability of delay discounting. *Biological Psychiatry*, *77*(10), 887-894.

Aycinena, D., & Rentschler, L. (2017). Discounting and digit ratio: Low 2D: 4D predicts patience for a sample of females. *Frontiers in Behavioral Neuroscience*, *11*, 257.

Baker, F., Johnson, M. W., & Bickel, W. K. (2003). Delay discounting in current and never-before cigarette smokers: similarities and differences across commodity, sign, and magnitude. *Journal of Abnormal Psychology*, *112*(3), 382.

Barkley, R. A., Edwards, G., Laneri, M., Fletcher, K., & Metevia, L. (2001). Executive functioning, temporal discounting, and sense of time in adolescents with attention deficit hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD). *Journal of Abnormal Child Psychology*, *29*(6), 541-556.

Becker, G. S., & Mulligan, C. B. (1997). The endogenous determination of time preference. *The Quarterly Journal of Economics*, *112*(3), 729-758.

Belsky, J., Steinberg, L., & Draper, P. (1991). Childhood experience, interpersonal development, and reproductive strategy: An evolutionary theory of socialization. *Child Development*, *62*(4), 647-670.

Belsky, J., Schlomer, G. L., & Ellis, B. J. (2012). Beyond cumulative risk: distinguishing harshness and unpredictability as determinants of parenting and early life history strategy. *Developmental Psychology*, *48*(3), 662.

Bevilacqua, L., & Goldman, D. (2013). Genetics of impulsive behaviour. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *368*(1615), 20120380.

Bickel, W. K., & Marsch, L. A. (2001). Toward a behavioral economic understanding of drug dependence: delay discounting processes. *Addiction*, *96*(1), 73-86.

Bittles, A. H. (2012). *Consanguinity in context* (Vol. 63). New York: Cambridge University Press.

Boyd, R., & Richerson, P. J. (1988). *Culture and the evolutionary process*. University of Chicago press.

Brañas-Garza, P., Cobo-Reyes, R. & Dominguez, A. (2006). Si él lo necesita: Gypsy fairness in Vallecas. *Experimental Economics*, *9*(3): 253-264.

Brumbach, B. H., Figueredo, A. J., & Ellis, B. J. (2009). Effects of harsh and unpredictable environments in adolescence on development of life history strategies. *Human Nature*, *20*(1), 25-51.

Bulley, A., & Pepper, G. V. (2017). Cross-country relationships between life expectancy, intertemporal choice and age at first birth. *Evolution and Human Behavior*, *38*(5), 652-658.

Bulley, A., Pepper, G. V., & Suddendorf, T. (2017). Using foresight to prioritise the present. *Behavioral and Brain Sciences*, *40*.

Casals, M., Pila, P., Langohr, K., Millet, J. P., Caylà, J. A., & Roma Population Working Group. (2011). Incidence of infectious diseases and survival among the Roma population: a longitudinal cohort study. *The European Journal of Public Health*, ckq204.

Cavalli-Sforza, L. L., & Feldman, M. W. (1981). *Cultural Transmission and Evolution: A Quantitative Approach* (No. 16). New Jersey: Princeton University Press.

Cavalli-Sforza, L. L., Moroni, A., & Zei, G. (2004). *Consanguinity, inbreeding, and genetic drift in Italy* (Vol. 39). Princeton University Press.

Cerezo, A. I. (2016). Women in Prison in Spain: The Implementation of Bangkok Rules to the Spanish Prison Legislation. *European Journal on Criminal Policy and Research*, *23*(2), 133-151.

Chabris, C. F., Laibson, D., Morris, C. L., Schuldt, J. P., & Taubinsky, D. (2008). Individual laboratory-measured discount rates predict field behavior. *Journal of Risk and Uncertainty*, *37*(2-3), 237.

Chipman, A., & Morrison, E. (2015). Experimentally induced stress decreases ideal female reproductive timing. *Psychoneuroendocrinology*, *62*, 89-95.

Cook, B., Wayne, G. F., Valentine, A., Lessios, A., & Yeh, E. (2013). Revisiting the evidence on health and health care disparities among the Roma: a systematic review 2003–2012. *International Journal of Public Health*, *58*(6), 885-911.

Daly, M., & Wilson, M. (2005). Carpe diem: Adaptation and devaluing the future. *The Quarterly Review of Biology*, *80*(1), 55-60.

del Giudice, M., Gangestad, S. W., & Kaplan, H. S. (2015). Life history theory and evolutionary psychology. *The handbook of evolutionary psychology. Vol. 1. Foundations*, 88-114.

Dickins, T. E., Johns, S. E., & Chipman, A. (2012). Teenage pregnancy in the United Kingdom: A behavioral ecological perspective. *Journal of Social, Evolutionary, and Cultural Psychology*, *6*(3), 344.

Dombrovski, A. Y., Szanto, K., Siegle, G. J., Wallace, M. L., Forman, S. D., Sahakian, B., ... & Clark, L. (2011). Lethal forethought: delayed reward discounting differentiates high-and low-lethality suicide attempts in old age. *Biological Psychiatry*, *70*(2), 138-144.

Eisenstein, S. A., Gredysa, D. M., Antenor–Dorsey, J. A., Green, L., Arbeláez, A. M., Koller, J. M., ... & Hershey, T. (2015). Insulin, central dopamine D2 receptors, and monetary reward discounting in obesity. *PloS one*, *10*(7), e0133621.

Ellis, B. J. (2004). Timing of pubertal maturation in girls: an integrated life history approach. *Psychological Bulletin, 130*(6), 920.

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk. *Human Nature, 20*(2), 204-268.

Espín, A. M., Brañas-Garza, P., Herrmann, B., & Gamella, J. F. (2012). Patient and impatient punishers of free-riders. *Proceedings of the Royal Society of London B: Biological Sciences, 279*(1749), 4923-4928.

Espín, A. M., Brañas-Garza, P., Gamella, J.F., Herrmann, B. & Martín, J. (2018). Bringing together "old" and "new" ways of solving social dilemmas: the case of Spanish *Gitanos*. *Unpublished*.

Espín, A. M., Exadaktylos, F., Herrmann, B., & Brañas-Garza, P. (2015). Short-and long-run goals in ultimatum bargaining: impatience predicts spite-based behavior. *Frontiers in Behavioral Neuroscience, 9*, 214.

Feintuch, S. (2013). *Power, Perceptions, and Incarceration: An Analysis of Spain's New External Units for Imprisoned Mothers and Children*. Doctoral dissertation, Central European University.

Frankenhuis, W. E., Panchanathan, K., & Nettle, D. (2016). Cognition in harsh and unpredictable environments. *Current Opinion in Psychology*, *7*, 76-80.

Fraser, A. (1995). *The gypsies*. Oxford: Wiley-Blackwell.

Frederick, S., Loewenstein, G., & O'Donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of Economic Literature, 40*(2), 351-401.

Gamella, J. F. (1996). *La población gitana en Andalucía: un estudio exploratorio de sus condiciones de vida*. Sevilla: Consejería de Trabajo y Asuntos Sociales, Junta de Andalucía.

Gamella, J. F., Martín, E. (2007). Vien avec moi cousine. Le mariage entre cousins germains chez le Gitans Andalous. *Etudes Tsiganes, 30*(2), 110-151.

Gamella, J. F. (2011). *Historias de éxito. Modelos para reducir el abandono escolar de la adolescencia gitana*. Madrid: Ministerio de Educación, Gobierno de España.

Gamella, J. F., Martín Carrasco-Muñoz, E., & Núñez Negrillo, A. M. (2013). Oculocutaneous albinism and consanguineous marriage among Spanish *Gitanos* or Calé–a study of 83 cases. *Collegium Antropologicum*, *37*(3), 723-734.

Gamella, J. F., Martín Carrasco-Muñoz, E., & Quesada Garrido, A. (2014). New methodological approaches in the anthropological demography of Romani groups. An example from the study of the evolution of the infant and child mortality of the *Gitanos* or Calé of Spain (1871-2007). *Sociologia de Universidade Do Porto*, 175-204.

Gamella, J.F., & Martín, E. (2017). The decline of infant and child mortality among Spanish *Gitanos* or Calé (1871-2005). A microdemographic study in Andalusia. *Demographic Research*, *36*, 945-988.

Green, L., Myerson, J., Lichtman, D., Rosen, S., & Fry, A. (1996). Temporal discounting in choice between delayed rewards: the role of age and income. *Psychology and Aging*, *11*(1), 79.

Griskevicius, V., Tybur, J. M., Delton, A. W., & Robertson, T. E. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: a life history theory approach. *Journal of Personality and Social Psychology*, *100*(6), 1015.

Harrison, G. W., Lau, M. I., & Williams, M. B. (2002). Estimating individual discount rates in Denmark: A field experiment. *The American Economic Review*, *92*(5), 1606-1617.

Hill, E. M., Jenkins, J., & Farmer, L. (2008). Family unpredictability, future discounting, and risk taking. *The Journal of Socio-Economics*, *37*(4), 1381-1396.

Johns, S. E., Dickins, T. E., & Clegg, H. T. (2011). Teenage pregnancy and motherhood: How might evolutionary theory inform policy?. *Journal of Evolutionary Psychology*, *9*(1), 3-19.

Kalaydjieva, L., Gresham, D., & Calafell, F. (2001). Genetic studies of the Roma (Gypsies): a review. *BMC Medical Genetics*, *2*(1), 5.

Kalaydjieva, L., Morar, B., Chaix, R., & Tang, H. (2005). A newly discovered founder population: the Roma/Gypsies. *Bioessays*, *27*(10), 1084-1094.

Kaplan, H. S., & Gangestad, S. W. (2005). Life history theory and evolutionary psychology. *The Handbook of Evolutionary Psychology*, 68-95.

Kidd, C., Palmeri, H., & Aslin, R. N. (2013). Rational snacking: Young children's decision-making on the marshmallow task is moderated by beliefs about environmental reliability. *Cognition*, *126*(1), 109-114.

Kirby, K. N., Godoy, R., Reyes-Garcia, V,, Byron, E., Apaza, L., Leonard, W., Perez, E., Vadez, V. & Wilkie, D. (2002). Correlates of delay-discount rates: Evidence from Tsimane' Amerindians of the Bolivian rain forest. *Journal of Economic Psychology*, *23*(3), 291-316.

Kirby, K. N. (2009). One-year temporal stability of delay-discount rates. *Psychonomic Bulletin & Review*, *16*(3), 457-462.

La Parra Casado, D., Gil González, D., & de la Torre Esteve, M. (2016). The social class gradient in health in Spain and the health status of the Spanish Roma. *Ethnicity & Health*, *21*(5), 468-479.

Lee, A. J., Debruine, L. M., & Jones, B. C. (2018). Individual-specific mortality is associated with how individuals evaluate future discounting decisions. *Proceedings of the Royal Society of London B: Biological Sciences*. DOI: 10.1098/rspb.2018.0304.

Lopez-Guzman, S., Konova, A. B., Louie, K., & Glimcher, P. W. (2018). Risk preferences impose a hidden distortion on measures of choice impulsivity. *PLoS ONE*, *13*(1), e0191357.

Lumsden, C. J., & Wilson, E. O. (1981). *Genes, mind, and culture: The coevolutionary process*. MA: Harvard University Press.

Martín, E., & Gamella, J. F. (2005). Marriage practices and ethnic differentiation: The case of Spanish Gypsies (1870–2000). *The History of the Family*, *10*(1), 45-63.

Mathot, K. J., & Frankenhuis, W. E. (2018). Models of pace-of-life syndromes (POLS): a systematic review. *Behavioral Ecology and Sociobiology*, *72*(3), 41.

Matras, Y. (2015). *The Romani Gypsies*. Cambridge: Harvard University Press.

McCullough, M. E., Pedersen, E. J., Schroder, J. M., Tabak, B. A., & Carver, C. S. (2013). Harsh childhood environmental characteristics predict exploitation and retaliation in humans. *Proceedings of the Royal Society of London B: Biological Sciences*, *280*(1750), 20122104.

McElreath, R., Boyd, R., & Richerson, P. (2003). Shared norms and the evolution of ethnic markers. *Current Anthropology*, *44*(1), 122-130.

McGuire, J. T., & Kable, J. W. (2013). Rational temporal predictions can underlie apparent failures to delay gratification. *Psychological review*, *120*(2), 395-410.

Meier, S., & Sprenger, C. (2010). Present-biased preferences and credit card borrowing. *American Economic Journal: Applied Economics*, *2*(1), 193-210.

Meier, S., & Sprenger, C. D. (2012). Time discounting predicts creditworthiness. *Psychological Science*, *23*(1), 56-58.

Mejía-Cruz, D., Green, L., Myerson, J., Morales-Chainé, S., & Nieto, J. (2016). Delay and probability discounting by drug-dependent cocaine and marijuana users. *Psychopharmacology*, *233*(14), 2705-2714.

Mell, H., Safra, L., Algan, Y., Baumard, N., & Chevallier, C. (2018). Childhood environmental harshness predicts coordinated health and reproductive strategies: A cross-sectional study of a nationally representative sample from France. *Evolution and Human Behavior*, *39*(1), 1-8.

Ministerio de Sanidad y Consumo - Fundación Secretariado Gitano (2005). *Health and the Roma Community*. Madrid: Ministerio de Sanidad y Consumo, Gobierno de España. https://www.msssi.gob.es/fr/profesionales/saludPublica/prevPromocion/promocion/desigualdadSalud/docs/Health_and_the_Roma_Community.pdf (accessed 2017-03-18).

Nettle, D., Coall, D. A., & Dickins, T. E. (2010). Birthweight and paternal involvement predict early reproduction in British women: evidence from the National Child Development Study. *American Journal of Human Biology*, *22*(2), 172-179.

Nettle, D., Coall, D. A., & Dickins, T. E. (2011). Early-life conditions and age at first pregnancy in British women. *Proceedings of the Royal Society of London B: Biological Sciences*, *278*(1712), 1721-1727.

Núñez Negrillo, A. M. (2016). *Un siglo de matrimonios consanguíneos en la archidiócesis de Granada (1900-1999). Un análisis antropológico*. PhD Dissertation, University of Granada.

Ohmura, Y., Takahashi, T., Kitamura, N., & Wehr, P. (2006). Three-month stability of delay and probability discounting measures. *Experimental and Clinical Psychopharmacology*, *14*(3), 318.

Pender, J. L. (1996). Discount rates and credit markets: Theory and evidence from rural India. *Journal of Development Economics*, *50*(2), 257-296.

Pepper, G. V., & Nettle, D. (2017). The behavioural constellation of deprivation: causes and consequences. *Behavioral and Brain Sciences*, 40, E314. doi:10.1017/S0140525X1600234X.

Promislow, D. E., & Harvey, P. H. (1990). Living fast and dying young: A comparative analysis of life-history variation among mammals. *Journal of Zoology*, *220*(3), 417-437.

Rachlin, H., & Green, L. (1972). Commitment, choice and self-control. *Journal of the Experimental Analysis of Behavior*, *17*(1), 15-22.

Ramos, D., Victor, T., Seidl-de-Moura, M. L., & Daly, M. (2013). Future discounting by slum-dwelling youth versus university students in Rio de Janeiro. *Journal of Research on Adolescence*, *23*(1), 95-102.

Rawls J. (1971). *A Theory of Justice*. Cambridge, MA: Harvard University Press.

Read, D., & Read, N. L. (2004). Time discounting over the lifespan. *Organizational Behavior and Human Decision Processes*, 94(1), 22-32.

Read, D., & Van Leeuwen, B. (1998). Predicting hunger: The effects of appetite and delay on choice. *Organizational behavior and human decision processes*, *76*(2), 189-205.

Reimers, S., Maylor, E. A., Stewart, N., & Chater, N. (2009). Associations between a one-shot delay discounting measure and age, income, education and real-world impulsive behavior. *Personality and Individual Differences, 47*(8), 973-978.

Réale, D., Garant, D., Humphries, M. M., Bergeron, P., Careau, V., & Montiglio, P. O. (2010). Personality and the emergence of the pace-of-life syndrome concept at the population level. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *365*(1560), 4051-4063.

Reynolds, B., Ortengren, A., Richards, J. B., & de Wit, H. (2006). Dimensions of impulsive behavior: Personality and behavioral measures. *Personality and Individual Differences*, *40*(2), 305-315.

Roff, D. (Ed.). (1993). *Evolution of life histories: theory and analysis*. New York: Chapman & Hall.

Salali, G. D., & Migliano, A. B. (2015). Future discounting in Congo basin hunter-gatherers declines with socio-economic transitions. *PLoS ONE*, *10*(9), e0137806.

Sen, A. (1992). *Inequality Reexamined*. Oxford, NY: Clarendon Press.

Sozou, P. D. & Seymour, R. M. (2003). Augmented discounting: interaction between aging and time-preference behavior. *Proceedings of the Royal Society of London B: Biological Sciences* 270, 1047-1053

Stojek, M. M., Fischer, S., Murphy, C. M., & MacKillop, J. (2014). The role of impulsivity traits and delayed reward discounting in dysregulated eating and drinking among heavy drinkers. *Appetite, 80*, 81-88.

Sutter, M., Kocher, M. G., Glätzle-Rützler, D., & Trautmann, S. T. (2013). Impatience and uncertainty: Experimental decisions predict adolescents' field behavior. *The American Economic Review*, *103*(1), 510-531.

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and time preferences: linking experimental and household survey data from Vietnam. *The American Economic Review*, *100*(1), 557-571.

Weller, R. E., Cook, E. W., Avsar, K. B., & Cox, J. E. (2008). Obese women show greater delay discounting than healthy-weight women. *Appetite*, *51*(3), 563-569.

Woodburn, J. (1980). *Hunters and gatherers today and reconstruction of the past*. US: Soviet and Western Anthropology.

Woodburn, J. (1982). Social dimensions of death in four African hunting and gathering societies. *Death and the Regeneration of Life*, 187-210.

Worthman, C. M. (2003). Energetics, sociality, and human reproduction: life history theory in real life. *Offspring: Human Fertility Behavior in Biodemographic Perspective*, 289-321.

Yi, R., Mitchell, S. H., & Bickel, W. K. (2010). Delay discounting and substance abuse-dependence. In: *Impulsivity: The behavioral and neurological science of discounting* (Eds.: G. McFadden & W. Bickel), 191-211, Columbia: APA Publishers.

Zietsch, B. P. (2016). Individual differences as the output of evolved calibration mechanisms: Does the theory make sense in view of empirical observations?. *Current Opinion in Psychology*, *7*, 71-75.

Capítulo 4:
Does intergroup discrimination undermine the future? Cross-country evidence of a link between group grievance and short-run orientation

4 Does intergroup discrimination undermine the future? Cross-country evidence of a link between group grievance and short-run orientation

Abstract

An evolutionary account for the existence of individual differences in temporal discounting (i.e., the orientation to the short- vs. the long-run) establishes that harsh socio-ecological conditions lead individuals to adaptively develop a short-run orientation, whereas more secure environments lead to the development of more long-run oriented individuals. Recent studies demonstrate that countries with higher Life Expectancy (a [negative] proxy for environmental harshness) have more long-run oriented citizens, which supports the evolutionary account. A related study shows that members of an ethnic group which has suffered a long history of discrimination and persecution are more short-run oriented than members of the dominant majority even after controlling for individual (current) socioeconomic status. The latter result led to the conjecture that intergroup discrimination processes generate environmental harshness which in turn make individuals involved in these processes to discount the future more heavily. Here we test the validity of such an argument using country-level data on temporal discounting (two separate cross-section datasets with 76 and 52 countries), environmental harshness and intergroup discrimination, and find strong support based on structural equation modeling. We further test a set of measures of ethnic fragmentation (indexes of fractionalization, segregation, polarization, and inequality) as possible drivers of intergroup discrimination and find mixed evidence, although always in the hypothesized direction, with segregation and, to a lesser extent, fractionalization apparently giving the best fit.

4.1 Introduction

Over the course of their lives, human beings, just like other animals, are constantly making decisions involving a trade-off between immediate and future gains (or losses). The sacrificing of an immediate reward for a larger reward in the future frequently plays an essential role in such decisions. This intertemporal trade-off can determine how certain dilemmas are resolved, for example the choice between investment in education and leisure, between saving and spending, between healthy and unhealthy behavior or between cooperative and selfish or even aggressive patterns (Story et al. 2014, Curry et al. 2008, Espín et al. 2012, 2015, 2017, Meier & Sprenger 2012).

As a general rule, we can say that intertemporal decisions are characterized by a reduction in the subjective value of rewards according to the delay involved in receiving them (Ainslie 1975, Rachlin & Green 1972). Impatience or temporal discounting (TD), as a result of the above, is defined as the individual's preference for immediate rewards rather than greater rewards which will be obtained at a later date.

Experimental studies measuring the TD of participants have cast considerable light on the bases of patience (Harrison et al. 2002, Kirby & Maraković 1996, McClure et al. 2004, Kable & Glimcher 2007), with one of the most common findings being the wide heterogeneity among individuals (Frederick et al. 2002). The results suggest that people differ significantly in the way they make decisions about the future, and that while there are more impatient individuals who prefer immediate rewards there are also others who are more patient and tend to wait longer. Although TD can be temporarily manipulated (Kidd et al. 2013, Read & Van Leeuwen, 1998), there is a marked consistency in individual TD differences (Kirby 2009, Ohmura et al. 2006).

However, the origins of such individual differences remain largely unknown. What makes some people more patient than others? Certain evidence points towards a hereditary basis for TD (Anokhin et al. 2011, Aycinema & Rentschler 2018, Bevilaqua & Goldman 2013), while other studies have indicated that factors such as socioeconomic status may influence its development or the manner in which it is displayed (Harrison et al. 2002, Kirby et al. 2002, Tanaka et al. 2010). Nevertheless, there is still much to learn in regard to the roots of TD.

Evolutionary accounts based on Life History Theory provide a basis for the understanding of TD from an adaptationist perspective: individuals discount the future because the information present within their environment suggests uncertainty over whether the organism will survive long enough to receive future rewards (Becker and Mulligan 1997, Daly & Wilson 2005, Frankenhuis et al. 2016, Hill et al. 2008, Pepper & Nettle 2017). The most influential models based on Life History Theory define living strategies in terms of the allocation of organism resources to the various vital functions (reproduction, food supply, caring for offspring, etc.), within a fast-slow continuum (Kaplan & Gangestad 2005, del Giudice et al. 2015, Roff 1993). Life History strategies are developed as an adaptation to the specific context in order to maximize the reproductive success of the individual and involve a series of what are known as Life History traits.

In this way the harsher and most unpredictable environments lead to faster life strategies (with traits including high and early fertility) which detract future resources in favor of immediate objectives, while safer and more predictable environments lead to the development of slow strategies, that is, at the other end of the continuum (with characteristics such as a reduced or later fertility). On the basis of these arguments, heavily discounting the future, far from representing a maladaptive behavior, can actually be an appropriate response in the context of harsh or unpredictable environments (Brumbach et al. 2009, Dickins et al. 2012, Frankenhuis et al. 2016, Johns et al. 2011). According to this theoretical framework, the existence of differences in the socio-ecological conditions that individuals experience during the stages of development over which TD is established is a vital determining factor in individual TD differences (Griskevicius et al. 2011, Brumbach et al. 2009). Given that environmental cues will tend to be shared by a number of individuals, these theories implicitly reveal the "collective" nature of TD, in the sense that group differences may be key to explaining individual differences.

Following this line of thought, recent work comparing TD between populations have shown the existence of a link between the harshness of the socio-ecological environment and the TD of the individuals. The studies of Bulley & Pepper (2017) and Lee et al. (2018) found a positive relation between the average Life Expectancy of a country (a [negatve] proxy for the harshness of the environment) and the patience of its

inhabitants, using samples of university students and young participants (online sample), respectively, from over 50 different countries. On the other hand, expanding on the seminal work of Ramos et al. (2013), Martín et al. (2019) demonstrated that members of an ethnic minority which has suffered a long history of discrimination and persecution (the Spanish Romani people or *Gitanos*), and generally exhibits Life History traits which are (relatively) fast, tend to discount the future to a greater degree than their neighbours from the majority population, even after the effect of the current socioeconomic status is eliminated.

As an explanation of their results, Martín et al. (2019) suggest that the existence of intergroup discrimination processes lead to the proliferation of harsh socio-ecological environments (or those perceived as such) which, in turn, result in those individuals involved in intergroup conflicts increasing their preference for short-term choices. Put another way, intergroup conflict situations increase the TD of individuals, in particular those most affected by discrimination, via a harshening of the socio-ecological conditions they face.

This argument, if shown to be valid, would have significant implications. After all, intergroup conflict and discrimination are inherent to human being (Tajfel et al. 1979). The theories of (cultural) group selection, for example, emphasize the importance of intergroup competition processes in the evolution of the human race and many of its distinctive characteristics, in aspects such as cooperation, the enforcements of norms, learning, etc. (Henrich 2004, Sober & Wilson 2011, Boyd & Richerson 1988, Lumsden & Wilson 1981). Intergroup processes first need group identities to be established, in other words, they require the existence of clearly identifiable attributes which distinguish some people from others, and thereby enable their grouping on the basis of these characteristics, with ethnic origin being one of the most commonly employed categorizations for identification and differentiation (Sen, 1992). In this way, following the hypothesis of Martín et al. (2019), intergroup discrimination processes would have an effect on the behavior of individuals not yet explored in the literature, which stems from a harshening of the socio-ecological conditions to which individuals respond by prioritizing the short-term.

In this study we will test the validity of this argument by means of structural equation models with country-level data using: (i) TD behavioral data obtained from two

recent surveys (Bulley & Pepper 2017, Falk et al. 2018); (ii) a proxy measure for the incidence of intergroup discrimination (Group Grievance Index; FSI 2018); and (iii) three proxies for the harshness of socio-ecological conditions (Life Expectancy, Infant Mortality Rate and GDP per capita). These variables were chosen because together they provide a substantial part of the environmental information essential to the development of life strategies according to Life History Theories: how long do I expect to live, how many of my children will survive and what material resources will be available to me (del Giudice et al. 2015). Figure 1 shows a representation of the starting conceptual framework.

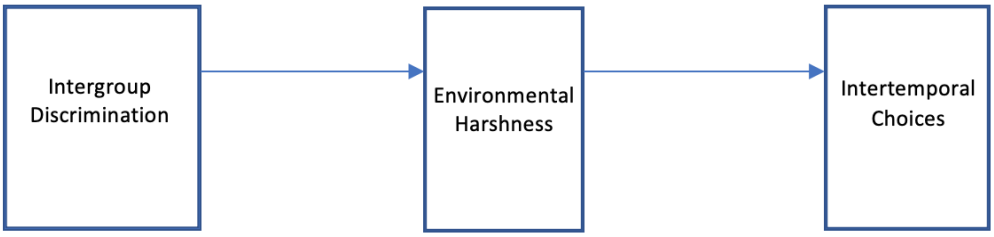


***Figure 1**: Basic Conceptual Framework*

To investigate the causes of intergroup discrimination processes, bearing in mind the results of Martín et al. (2019), we also looked at the impact of a series of variables which measure various aspects of the ethnic fragmentation of a country, which include the indexes of fractionalization (Montalvo & Reynal-Querol 2005a, Alesina et al. 2003), spatial segregation (Alesina & Zhuravskaya 2011), polarization (Montalvo & Reynal-Querol 2005b), and inequality (Alesina et al. 2016). In fact, as explained in the following section, conflicts of an ethnic nature play an important role in our measure of intergroup discrimination. However, the measure expands to include all types of indicators of discrimination and hatred between social and political groups.

More specifically, the aim was to test two main hypotheses via an empirical strategy which can be broadly summarized as follows. We first tested the following structural equation model:

(*Hypothesis 1*) intergroup discrimination harshens the socio-ecological conditions and this harshening, in turn, reduces the patience of individuals. (See Figure 2a)

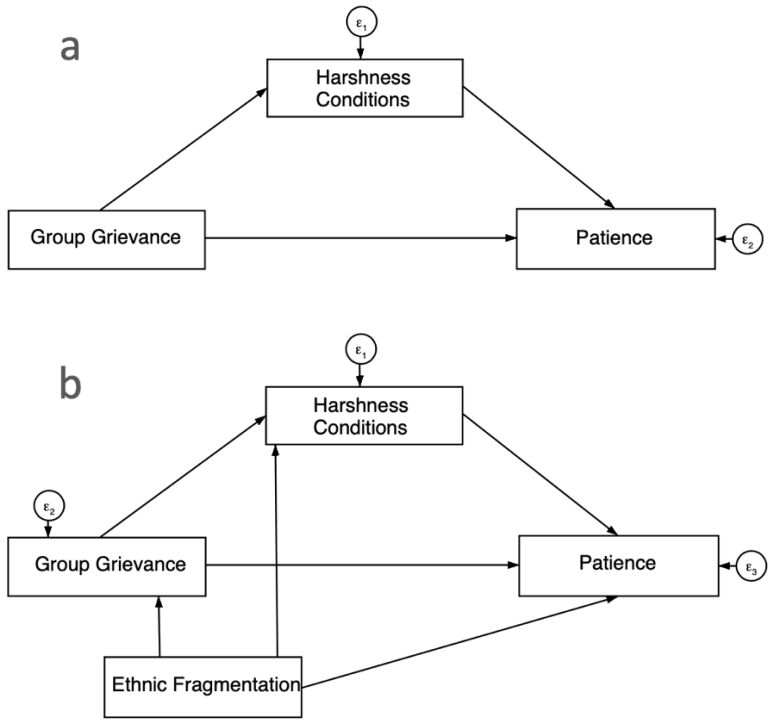


Figure 2. *Structural Equation Models testing (a) Hypothesis 1 and (b) Hypothesis 2*

And secondly, we tested a model in which:

(*Hypothesis 2*) ethnic fragmentation leads to greater intergroup discrimination, which harshens socio-ecological conditions and this, in turn, reduces the patience of individuals. (See Figure 2b)

The countries included in our study provide a broad worldwide representative sample, with wide ranging levels of development and cultural diversity, covering all continents. This has enabled us to obtain externally-valid results. Specifically, we have used 88 countries made up of 34 from Europe, 15 from the Americas, 22 from Asia, including 6 from the Middle East, 2 from Oceania and 15 from Africa. This list of countries covers approximately 90% of the world's population and global income. Although we had available data from a greater number of countries for some of the indicators used, we restricted the sample to those included in one of the two TD databases.

In the two TD databases, and using any of the three environmental harshness measures, we found a strong negative link between the proxy of intergroup discrimination

by country and the patience of its habitants which is mediated from 20% to 80%, depending on the specification of the model, by the environmental harshness conditions within that country. As such, these results are clearly in line with *Hypothesis 1*.

In terms of the effect of ethnic fragmentation as a precursor to intergroup discrimination, the results are not as conclusive and vary depending on the TD database used. The measurements of segregation and, to a lesser extent, fractionalization seem to adjust slightly better to the predictions of *Hypothesis 2* than the measurements of inequality and, especially, ethnic polarization. However, it is more difficult to reach firm conclusions from this analysis given that, although the results always point in the direction established under Hypothesis *2*, the overall estimated effects of the ethnic fragmentation variables on patience are at times not statistically significant and there are considerable differences depending on which TD measurement is used.

On the one hand, these results contribute towards reinforcing the evidence of the impact of socio-ecological conditions on the intertemporal decisions of individuals, thereby supporting the models based on Life History Theory (Ellis, 2009, Belsky et al. 2012). On the other hand, we offer evidence in favor of an explanation to the already famous (negative) link between ethnic fragmentation and economic prosperity (Easterly & Levine 1997, Alesina et al. 1999, see Alesina & La Ferrara 2005 for a review of the literature), articulated through the intergroup discrimination processes.

Our main contribution, however, is that we offer a new perspective from which to study the effects of discrimination and intergroup conflict on the behavior of individuals (Abbink et al. 2010, Tajfel et al. 1979), in particular, on their intertemporal decisions. Although the cross-section nature of the data used does not allow an accurate analysis of the causality of the relationships, the results obtained do provide clear support for the conceptual framework. Previous studies suggest that exposure to violent conflicts is associated with a preference for the short-term (Voors et al. 2012, Imas et al. 2018). Our results, assuming a correlation between intergroup discrimination and violent conflict, are also in line with this literature, to which we would add a more holistic approximation based on the evolutionist framework of Life History Theory.

The rest of the article is structured as follows. In the next section we present the methodology employed and the variables included in the statistical analysis. In the third

section the empirical results are presented and the final section discusses the results and concludes.

4.2 Materials and Methods

4.2.1 Measures

Intergroup Discrimination - Group Grievance

This variable has been extracted from the "Fragile States Index" website (http://fundforpeace.org/fsi/data/) developed by the "Fund For Peace" (FFP). The FFP was established during the 1990's as a framework for a better understanding and evaluation of the driving forces and dynamics of conflicts in troubled environments. Within the various country-level indicators developed by the FFP, we have focused on Group Grievance. We have found this to be the most reliable indicator on the topic and, above all, the closest to the concept of intergroup discrimination we are dealing with here.

Group Grievance is an indicator which focuses on the divisions between various groups within the society, particularly those based on social or political characteristics, their role in access to services or resources and inclusion within the political process. This indicator also has a historical component, where the aggrieved groups cite past injustices, such as denial of the rights of autonomy, self-determination or political independence to which they feel entitled – all of which influence and give shape to the role of this group within the society and relations with other groups. The indicator also considers specific groups who have been subjected to persecution or repression by the state authorities or dominant groups, or who have been made public scapegoats by those who believe they have acquired wealth, status or power "illegitimately", a situation which can be manifested in displays of hatred, propaganda and nationalist political discourse.

The ethnic component is clearly important to the construction of this index, however the perspective adopted is much broader and includes all examples of confrontations and conflicts (violent or otherwise) between groups from different backgrounds, both social and political, religious or other types. This can be appreciated by observing the elements which make up this multifactorial indicator. Among the questions which the FFP takes into account when building the Group Grievance index are "truth and reconciliation" (are truth and reconciliation processes planned or underway?

Are they necessary?), "compensation for the victims" (have the victims of past atrocities received compensation, or is there a plan in place to compensate them?), "hatred vs. group tolerance" (how far is ethnic or religious violence and/or intolerance supported or denounced?), "group oppression" (are there oppressed groups or those that feel oppressed?), "history" (is there a history of violence or abuse against specific groups?), "intergroup relations" (how are relations between tribes or ethnic groups?), and "mass violence" (have incidents of mass violence or murder been reported?).

We have taken the data for 2010, in order to coincide with the year analyzed for the other variables on which data exists for different periods (see below). The indicator registers values from 0 to 10, with our collected sample displaying practically the whole possible range, from 1.0 in Ireland to 9.7 in Afghanistan, as shown in Table 1. As with the other measurements, Group Grievance was standardized at the country level for the analysis. As can be seen in Figure 3, the countries from the sample with the highest Group Grievance levels are Afghanistan, Sri Lanka, Israel, Nigeria, Pakistan, Iraq, Lebanon, Kenya, Bangladesh and Zimbabwe. The countries with lowest Group Grievance are Ireland, Finland, Norway, Sweden, Portugal, Denmark, Canada, Hungary and Luxembourg.

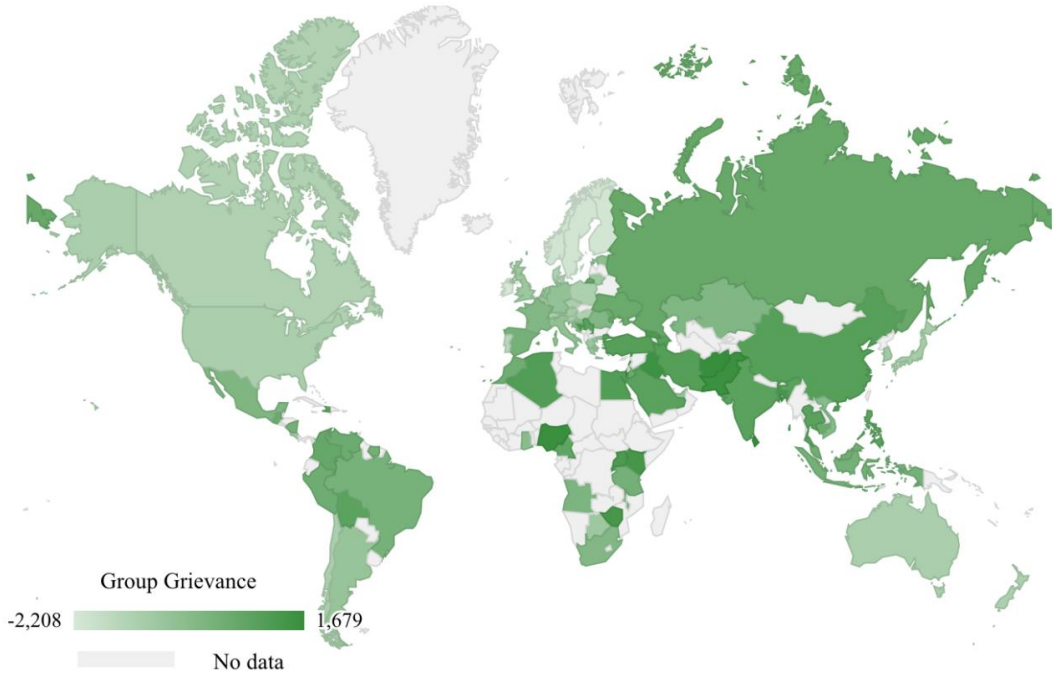


***Figure 3**. World distribution of Group Grievance. See interactive maps on http://bit.ly/worlddistribution*

Intertemporal Choices

In order to achieve greater robustness in the results, we used two alternative patience measures for our study which were compiled in different ways, both equally valid but each with its own advantages and disadvantages. The first measure (Patience FAL, Falk et al. 2018) is principally characterized by a larger number of countries, with a more detailed TD evaluation and samples which are more representative of the general population of each country. On the other hand, the second measure (Patience BP) has been employed in the first article analyzing the relationship between Life Expectancy and TD from a Life History perspective (Bulley & Pepper 2017) and provides comparable university student samples, with relatively consistent characteristics (similar socio-economic status and intellectual levels) which, under certain circumstances, may facilitate the detection of true national or cultural differences (Gächter 2010, Herrmann et al. 2008). For the 40 countries included in both databases, the correlation between the two patience measures is 0.593 (see Table 2 in the Results section). We will go on to describe each measure in more detail.

Patience FAL

This discounting measure is taken from the article by Falk et al. (2018). In this case, the so-called Global Preference Survey was conducted on 80,000 individuals from 76 different countries, with a sample size of more than 1,000 participants per country selected by probability sampling. A series of data was compiled on temporal preference, risk preference, altruism, trust and positive and negative reciprocity through an experimentally validated survey (Falk et al. 2016). The data was collected within the framework of the 2012 wave of the Gallup World Poll, a survey which includes representative samples of the population from a large number of countries and asks questions annually on social and economic issues. This information is publicly available on https://www.briq-institute.org/global-preferences/home.

The data collection process was conducted via an experimental validation procedure to select the survey questions, with the amounts involved in the decisions adjusted for purchasing power in order to balance all the countries. An initial test was performed to guarantee implementation within a culturally diverse sample and finally the data was compiled within the 2012 global survey. The entire process ensured that it was

possible to determine and construct averages by country and see how preferences varied from one to another.

To determine the preferences of individuals a combination of two questions was used. A self-reported measure, somewhat more abstract, where the subject was asked the question "how willing are you to give up something that is beneficial for you today in order to benefit more from that in the future?" The subjects were asked to respond on an 11-point Likert scale. This was combined with a quantitative measure where the subject made hypothetical choices in a series of five interdependent decisions between immediate (payment today) and delayed (payment in 12 months' time) rewards, using the stair-wise method (Cornsweet 1962). The quantitative question was given a 71% weighting in the measurement of patience of each individual. To maximize the validity of the measurement, the elements and their weighting were selected via an initial experimentally validated optimization procedure (Falk et al. 2016). The measures that we have used here refer to the average patience of the representative sample from each country, as calculated by Falk et al. (2018).

As can be seen in Figure 4a, the sample countries with the greatest average patience (lower TD) according to Falk et al. (2018), were, in order, Sweden, the Netherlands, USA, Canada, Switzerland, Australia, Germany, Austria, Finland and the UK. At the other end of the scale, the countries with the lowest level of patience were, in order, Nicaragua, Rwanda, Georgia, Hungary, Cameroon, Jordan, Iraq, Egypt, Iran and Haiti.

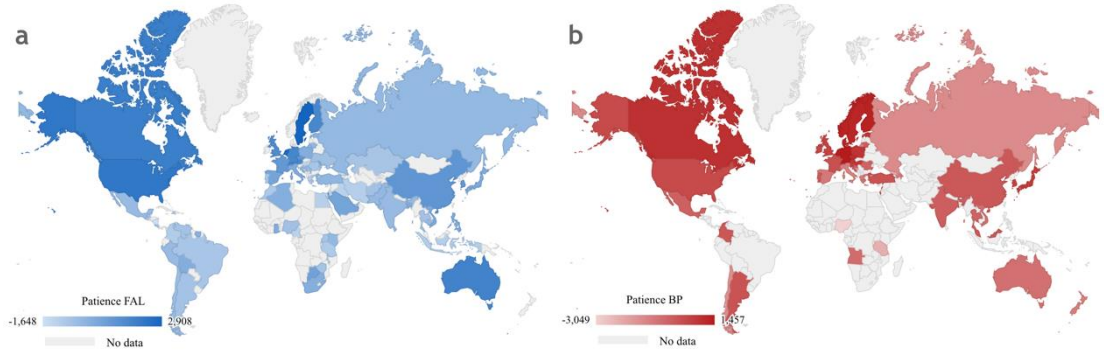


***Figure 4**. World distribution of (a) Patience FAL and (b) Patience BP. See interactive maps on http://bit.ly/worlddistribution*

Patience BP

This measure was extracted from the article by Bulley & Pepper (2017) using data compiled from the International Test of Risk Attitudes (INTRA) survey conducted by the University of Zurich which was made available to the public in the paper published by Wang et al. (2016). The country data was compiled between 2006 and 2012.

The TD task consisted of a single decision in which the subjects were asked to indicate whether they would prefer a hypothetical payment of $3400 this month or $3800 next month (Frederick 2005). The exact amounts were adjusted to the purchasing power of the participants in each country. The average patience of a country was indicated by the percentage of participants who chose the delayed payment, demonstrating a low level of TD, as calculated by Bulley & Pepper (2017).

The sample of participants consisted of 6901 individuals from 53 different countries. All were university students from different levels, the majority studying finance, business administration and economics. More details on the INTRA survey methodology are available in Wang et al. (2016) and Rieger et al. (2014). Following the methodology of Bulley & Pepper (2017), and given the wide diversity of the sample sizes (with countries where 38 observations were compiled, such as Georgia, up to 540 participants in Germany), all the analyses using this variable are weighted according to the sample size from each country. Similar to Bulley & Pepper (2017) we used 52 countries in our sample, given that for Taiwan there is no data available on Life Expectancy, GDP per capita or the Mortality Rate for 2010.

As can be seen in Figure 4b, the countries with the greatest patience (that is a higher percentage of individuals with lower TD rates) in accordance with the Bulley & Pepper (2017) measurement were Germany, Switzerland, Belgium, Finland, Holland, Norway, Sweden, Denmark, Czech Republic and Canada respectively. Likewise, the countries which show lower patience levels were Nigeria, Tanzania, Georgia, Chile, Bosnia-Herzegovina, Russia, Italy, New Zealand and Spain.

Measurements of socio-ecological conditions. Life Expectancy, Infant Mortality Rate and GDP per capita.

As mentioned above, Life Expectancy, Infant Mortality Rate and GDP per capita combine to provide a large part of the information on the environmental harshness most relevant to individuals' decisions on their Life History strategies, namely the risk of mortality for them and their offspring, and the scarceness of resources in their surroundings. The three variables have been extracted from World Bank (WB) data for 2010. We selected the data from 2010 as a mid-point between the patience data of Bulley & Pepper (2017), which was compiled between 2006 and 2012, and that of Falk et al. (2018), collected in 2012. In any case, the interannual variations of these variables are extremely small and the results do not vary qualitatively when using data from adjacent years. GDP and Life Expectancy were available for all 88 countries in the study, and Infant Mortality for all except Hong Kong. As can be seen in Table 2 of the Results section, the three proxies of environmental harshness are highly correlated (coefficients greater than 0.76, $p<0.001$). In order not to overload the second part of the analysis, the three measurements have been combined into a single indicator of environment harshness (Harshness Index) using factorial analysis (Cronbach's alpha=0.938; weighting: -0.922 for Life Expectancy, 0.968 for Infant Mortality Rate and -0.891 for GDP per capita; varimax rotation).

Life Expectancy. Life Expectancy at birth is expressed in years and for the two genders combined. The WB defines this as "the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life". Geographical distribution is shown in Figure 5a. As can be seen, among the sample countries with the highest Life Expectancy, in order, were Hong Kong, Japan, Switzerland, Italy, Australia, France, Spain, Israel, Sweden and Canada. Likewise, on the other end of the scale were Nigeria, Zimbabwe, Cameroon, South Africa, Uganda, Malawi, Angola, Botswana, Tanzania and Ghana.

Infant Mortality Rate. The actual variable used is the "Mortality rate for infants under 5 years old". The WB defines this as "under-five mortality rate is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to age-specific mortality rates of the specified year". The figure for Haiti was substituted for that of 2009, given that in 2010 Haiti suffered the worst earthquake in the region since 1770,

considered one of the largest humanitarian catastrophes in history, and as a result the Infant Mortality Rate for that year would be disproportionate and not correspond with normal values for our purposes. Following standard methodology, we used logarithms to reduce the skewness (towards the right) observed in the variable. As can be seen in Figure 5b, the sample countries with the highest Infant Mortality Rate, in order, were Nigeria, Angola, Cameroon, Pakistan, Afghanistan, Malawi, Zimbabwe, Haiti, Uganda and Tanzania. The countries with the lowest rates were Sweden, Luxembourg, Finland, Japan, Norway, Slovenia, Czech Republic, Spain and Greece.

GDP per capita. Gross domestic product per capita expressed in US dollars. The WB defines this variable as follows: "GDP per capita is gross domestic product divided by mid-year population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in current US dollars". As with the Infant Mortality Rate we used the logarithm of the variable to reduce the right-skewness of the distribution. As can be seen in Figure 5c, the sample countries with the highest GDP per capita were, in order, Luxembourg, Norway, Switzerland, Denmark, Sweden, Australia, the Netherlands, Ireland, USA and Canada. At the opposite end of the scale were Malawi, Afghanistan, Rwanda, Uganda, Haiti, Tanzania, Zimbabwe, Bangladesh, Cambodia and Kenya.

Harshness Index. As mentioned above, we combined the three proxies of socio-ecological conditions of the environment into a single variable so as not to overload the second part of the analysis. This variable has been labeled Harshness Index and measures the difficulty of the environment. In Figure 5d it can be seen that the sample countries with the largest environmental harshness, in order, were Nigeria, Zimbabwe, Cameroon, Malawi, Angola, Uganda, Afghanistan, Haiti, Tanzania and Pakistan. At the opposite end of the scale were Luxembourg, Norway, Sweden, Japan, Finland, Switzerland, Slovenia, Spain and Italy.

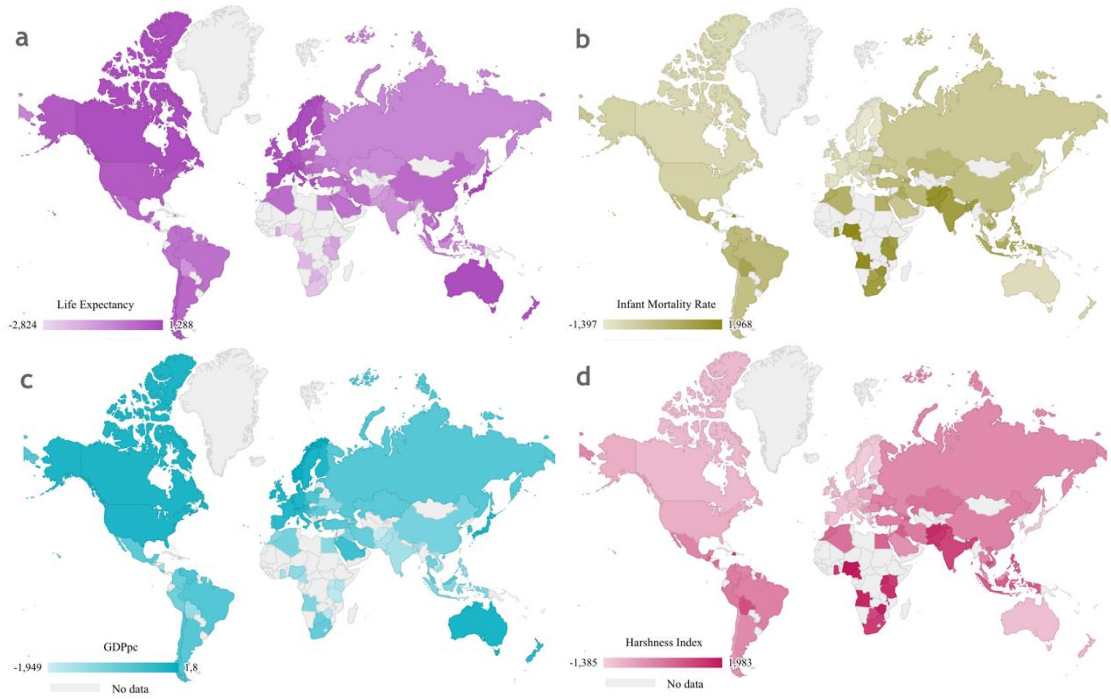


Figure 5*. World distribution of (a) Life Expectancy, (b) Infant Mortality Rate, (c) GDPpc, (d) Harshness Index. See interactive maps on http://bit.ly/worlddistribution*

Ethnic Fragmentation Measures

In the second part of the analysis we introduce the effect of ethnic fragmentation as a possible factor underlying intergroup discrimination, as defined under *Hypothesis 2*. Slightly distorting the language in order to facilitate the clarity of our argument, we have used the term "fragmentation" to group together the multiple possible forms of separation and heterogeneity between ethnon-cultural groups, stemming from both demographic and geographic factors, as well as other causes. Various possible representations of the fragmentation between ethnon-cultural groups within a country exist, whether through the number of different groups, their cultural or social characteristics, geographical location or distribution and size of the groups. It should be taken into account that ethnic classifications can be very complex and full of ambiguities, and it may be that the existing measures are insufficient to fully characterize the degree of heterogeneity of a country. For our analysis, in any case, we have used the sources providing the best ethnon-linguistic data and greatest diversity for the majority of world countries. There are essentially three main sources: World Christian Encyclopaedia, the Encyclopaedia Britannica and the Atlas Narodov Mira (1964).

To approximate the ethnic fragmentation within a country we have used the following indicators or measures (more details on these variables can be found in the Appendix):

Ethnic fractionalization. This refers to the coexistence of different ethnic groups within a region or country. Ethnic fractionalization is determined by the probability that two individuals selected at random from the population will belong to different groups. Easterly and Levine (1997) were the first to discuss and use this measure demonstrating the negative relationship between economic growth and the ethnic fractionalization of countries. We will use the measurements of Alesina et al. (2003) and Montalvo & Reynal-Querol (2005a), labeled respectively as **Ethnic Frac AAL** (Figure 6a) and **Ethnic Frac MRQ** (Figure 6b), to check the robustness of the results to possible changes in the measurement methodology. As with the other indicators, we have only considered the countries for which TD data also exist, using either Patience FAL or Patience BP.

Ethnic segregation. This we will define in geographical terms, such as the degree of ethnic homogeneity within the regions of a country. If we compare regions within a country, we would say that each region is completely homogenous if each ethnic group occupies a separate region, although the country as a whole is fractioned. On the other hand, we would say that there is no homogeneity within the regions if each region has the same varied ethnic composition as the entire country. The larger homogeneity within each region (and larger difference compared with the country as a whole), the larger the ethnic segregation within the country. The greatest segregation will occur when the various ethnic groups each occupy one specific geographic region. We will use the measurement employed by Alesina and Zhuravskaya (2011), labeled as **Ethnic Segregation** (Figure 6c), using logarithms to reduce the right-skewness observed in the variable.

Ethnic Polarization exists when a featureless section of the population splits into two exclusive groups with very distinctive traits or characteristics. If we imagine that a population of individuals may be divided according to a certain characteristic, in such a way that the resulting group is very homogenous in terms of the attributes of its members, but each group consists of members with very different attributes, the society would be polarized. When the population is divided ethnically, there exists a "distance" between ethnic traits which is difficult to evaluate with simple measurements and as such it is assumed that the distance between the groups will be constant between peers. As a result,

in order to calculate ethnic polarization, it is assumed that the absolute distance between any two groups is the same, which implies that the polarization measurements only depend on the size of the groups. If the distance between groups is kept constant, polarization is maximized when there are two groups of equal size, while fractionalization increases when there is proliferation of smaller groups. We will use the Montalvo & Reynal-Querol (2005b) ethnic polarization measure, which we will refer to as **Ethnic Polar** (Figure 6d).

We define **ethnic inequality** as the differences in welfare between the ethnic groups within a country or region. To determine the inequality between ethnic groups, ethnographic and linguistic maps determining the locations of the different groups are to be combined with a variable for material wellbeing, for instance, average income levels, for each of the identified locations. Given that obtaining income data for the ethnon-linguistic regions is practically impossible as they do not coincide with the administrative areas of the respective countries, the two ethnic inequality measures, extracted from Alesina et al. (2016), employ light density observed by satellite as a proxy for economic welfare (more light translating into enhanced welfare; Henderson et al. (2012). Once the material wellbeing of each ethnic group has been estimated, a Gini coefficient which measures the inequality between groups is calculated for the entire country. The two variables employed were developed in the same manner, with the only difference being the data employed in the geolocation process for the ethnic groups. Specifically, for this process, the measurement we have labelled **Ethnic Ineq ASN** (Figure 6e) uses the *Soviet Atlas Narodov Mira*, while the **Ethnic Ineq Ethnol** *(Figure 6f)* is based on the 15th edition of *Ethnologue.*

Each of these indicators reflects a different facet of the ethnic fragmentation of a country, although as can be seen in Table 2 they all correlate positively to a greater or lesser degree (coeffs>0.29, ps<0.05). Since there are reasons to believe that any of these measurements might impact positively on Group Grievance (in other words, on the existence of intergroup discrimination processes), we conduct a "horse race" to compare the explanatory power of each one. Ethnic fractionalization may increase intergroup discrimination, because the more ethnic groups there are, the larger probability that each group will experience clashes with one of the others. Ethnic segregation may lead to intergroup discrimination processes, for example if certain groups "appropriate" specific

territories where they are the majority, such as whole regions within a country; a situation which will add a territorial or secessionist conflict to an existing identity-based divide. Ethnic polarization may have similar results if, for example, the existence of a large-scale minority (rather than a number of smaller ones) leads to more far reaching conflicts between the groups and this in turn amplifies interethnic grievances. Lastly, ethnic inequality may undermine intergroup relations through, among other reasons, the effect of social comparisons or the abuse of power by the more economically fortunate groups, and result in a greater degree of discrimination.

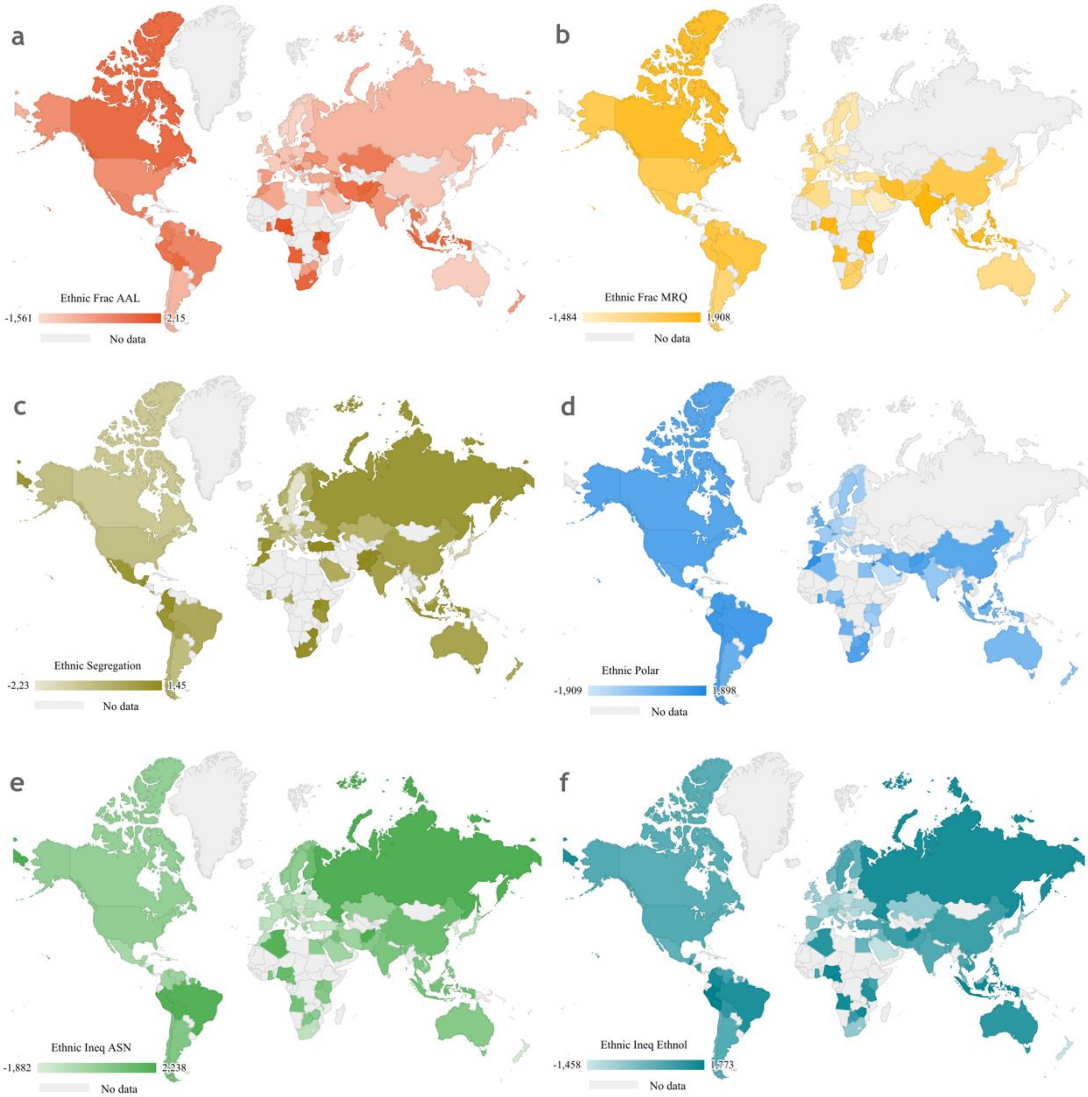


Figure 6. *World distribution of (a) Ethnic Frac AAL, (b) Ethnic Frac MRQ, (c) Ethnic Segregation, (d) Ethnic Polar, (e) Ethnic Ineq ASN, (f) Ethnic Ineq Ethnol. See interactive maps on http://bit.ly/worlddistribution*

4.2.2 Data Analysis

All the statistical analysis was conducted using Stata v. 14 (StataCorp). In the Results section, we first show the descriptive statistics of the variables employed. Secondly, we examine the Pearson correlations between all the variables and visually present the most significant relationships. Lastly, we report on the results of a set of structural equation models to test the Hypotheses presented (see Figure 2). Given the nature of the Hypotheses, we focused on the following:

- The total effects on patience of the variables considered exogenous (Group Grievance for *Hypothesis 1* and the ethnic fragmentation measurements for Hypothesis *2*) and endogenous (the socio-ecological measurements in both cases and Group Grievance for *Hypothesis 2*) for each model.
- The indirect effects of the exogenous variables on patience, mediated by each of the endogenous variables.
- The direct effects of the exogenous variables on the endogenous ones.

For each of the estimations performed, we used the maximum likelihood method assuming linearity in the relationships and report standardized coefficients for one specification not controlling for continent and another which includes continent dummies. Controlling for continent we eliminate the effect of other omitted variables, such as geographical or cultural factors, which might affect the relationships studied. The continent control was conducted via dummy variables (fixed effects) that impact on the socio-ecological conditions, which is a relatively conservative method given that the effects of the main country-level explanatory variables will in part be absorbed by the continent dummies. In the analyses which included the Patience BP TD measurement, the estimates will be weighted as in Bulley & Pepper (2017) using sample size weights.

4.3 Results

Descriptive Statistics

The descriptive statistics for the variables used are shown in Table 1. A total of 88 countries were considered, 76 using the Patience FAL variable and 52 using the Patience BP variable, with 40 countries sharing both databases. In Group Grievance one

observation was missing, namely Hong Kong, as well as in Infant Mortality Rate. Among the ethnic fragmentation measures, the one with the smallest number of observations was Ethnic Segregation with 65.

The Patience FAL variable was initially standardized at the individual level (Falk et al. 2018). The Infant Mortality Rate, GDP per capita and Ethnic Segregation were transformed into logarithms. For subsequent analysis and geographical distribution maps, all the variables were standardized at the country level to facilitate comparison.

Table 1. *Descriptive statistics*

Variable	Obs	Mean	Std. Dev.	Min		Max	
Patience FAL	76	-0.003	0.370	-0.613	(NIC)	1.071	(SWE)
Patience BP	52	0.628	0.180	0.080	(NGA)	0.890	(DEU)
Group Grievance	87	5.943	2.238	1	(IRL)	9.700	(AFG)
Life Expectancy	88	72.966	7.831	50.855	(NGA)	83.050	(HKG)
Infant Mortality Rate	87	1.156	0.486	0.477	(LUX)	2.113	(NGA)
GDPpc	88	3.888	0.629	2.662	(MWI)	5.021	(LUX)
Ethnic Frac AAL	88	0.398	0.247	0.012	(JPN)	0.930	(UGA)
Ethnic Frac MRQ	71	0.425	0.280	0.010	(PRT)	0.959	(TZA)
Ethnic Segregation	65	-1.493	0.750	-3.166	(DEU)	-0.405	(ZWE)
Ethnic Polar	70	0.503	0.253	0.020	(PRT)	0.982	(JOR)
Ethnic Ineq ASN	86	0.434	0.231	0	(KOR)	0.950	(AFG)
Ethnic Ineq Ethnol	86	0.443	0.304	0		0.982	(PER)

Notes: mean, standard deviation, minimum and maximum values of each variable. The ISO codes of the countries with the minimum and maximum values are displayed in parentheses. For Ethnic Ineq Ethol, there are 7 countries that share the minimum value of 0 (Croatia, Estonia, Haiti, Luxembourg, New Zealand, Ruanda and South Korea).

Relationships between the variables

In Table 2 we present the zero-order correlations between all the variables used. The large majority of the correlations are significant at standard levels. We will look here at the most relevant relationships and leave the rest for the Appendix. On the one hand, it

can be seen how Group Grievance significantly correlates with the other variables, the strongest being the positive relationship with (log) Infant Mortality Rate and the Harshness Index and the negative relationship with (log) GDP per capita (see Figure 7), all greater than 0.6 in absolute value. In addition, the correlation coefficients of Group Grievance with the two patience measures are around 0.5 (Figure 8) in absolute value, the same as with (log) Ethnic Segregation, which shows the highest correlation with Group Grievance among the ethnic fragmentation measures.

***Table 2**. Pearson correlations between the variables.*

	Patience FAL	Patience BP	Group Grievance	Life Expectancy	Infant Mortality R.	GDPpc	Harshness Index	Ethnic Frac AAL	Ethnic Frac MRQ	Ethnic Segregation	Ethnic Polar	Ethnic Ineq ASN	Ethnic Ineq Ethnol
PatienceFAL	1 76												
PatienceBP	0.594*** 40	1 52											
Group Grievance	-0.500*** 76	-0.491*** 51	1 87										
Life Expectancy	0.473*** 76	0.653*** 52	-0.554*** 87	1 88									
Infant Mortality R.	-0.527*** 76	-0.655*** 51	0.670*** 87	-0.914*** 87	1 87								
GDPpc	0.616*** 76	0.652*** 52	-0.716*** 87	0.814*** 88	-0.884*** 87	1 88							
Harshness Index	-0.546*** 76	-0.681*** 51	0.672*** 87	-0.945*** 87	0.993*** 87	-0.914*** 87	1 87						
Ethnic Frac AAL	-0.350** 76	-0.315* 52	0.427*** 87	-0.586*** 88	0.561*** 87	-0.457*** 88	0.564*** 87	1 88					
Ethnic Frac MRQ	-0.253* 62	-0.403* 39	0.462*** 70	-0.599*** 71	0.639*** 70	-0.550*** 71	0.627*** 70	0.849*** 71	1 71				
Ethnic Segregation	-0.355** 58	-0.384* 41	0.546*** 65	-0.505*** 65	0.575*** 65	-0.456*** 65	0.554*** 65	0.601*** 65	0.615*** 54	1 65			
Ethnic Polar	-0.178 61	-0.159 38	0.326** 69	-0.235+ 70	0.326** 69	-0.271* 70	0.295* 69	0.618*** 70	0.611*** 70	0.535*** 53	1 70		
Ethnic Ineq ASN	-0.193+ 75	-0.389** 51	0.332** 86	-0.449*** 86	0.512*** 86	-0.424*** 86	0.499*** 86	0.361*** 86	0.560*** 70	0.353** 65	0.294* 69	1 86	
Ethnic Ineq Ethnol	-0.165 75	-0.421** 51	0.332** 86	-0.491*** 86	0.587*** 86	-0.456*** 86	0.562*** 86	0.421*** 86	0.684*** 70	0.516*** 65	0.374** 69	0.765*** 86	1 86

Notes: We report correlation coefficient and number of observations for each relationship. +p<0.1, *p<0.05, **p<0.01, ***p<0.001

On the other hand, it was also observed that the sign of the relationship between all of the variables and the patience measurements is the same for Patience FAL and Patience BP, although the significance levels differ, especially in the case of the ethnic inequality measures which are not significant in the former but are in the latter case. There is a particularly marked relationship between the TD measures and the socio-ecological conditions (see Figure 9), all greater than 0.47 in absolute value and in the expected direction according to the literature (Bulley & Pepper 2017, Lee et al. 2018, Dohmen et al. 2018). In terms of the ethnic fragmentation measurements, the variable which seems to relate the least with patience (non-significant in both cases) and Group Grievance, as well as with the socio-ecological conditions measures, is Ethnic Polar.

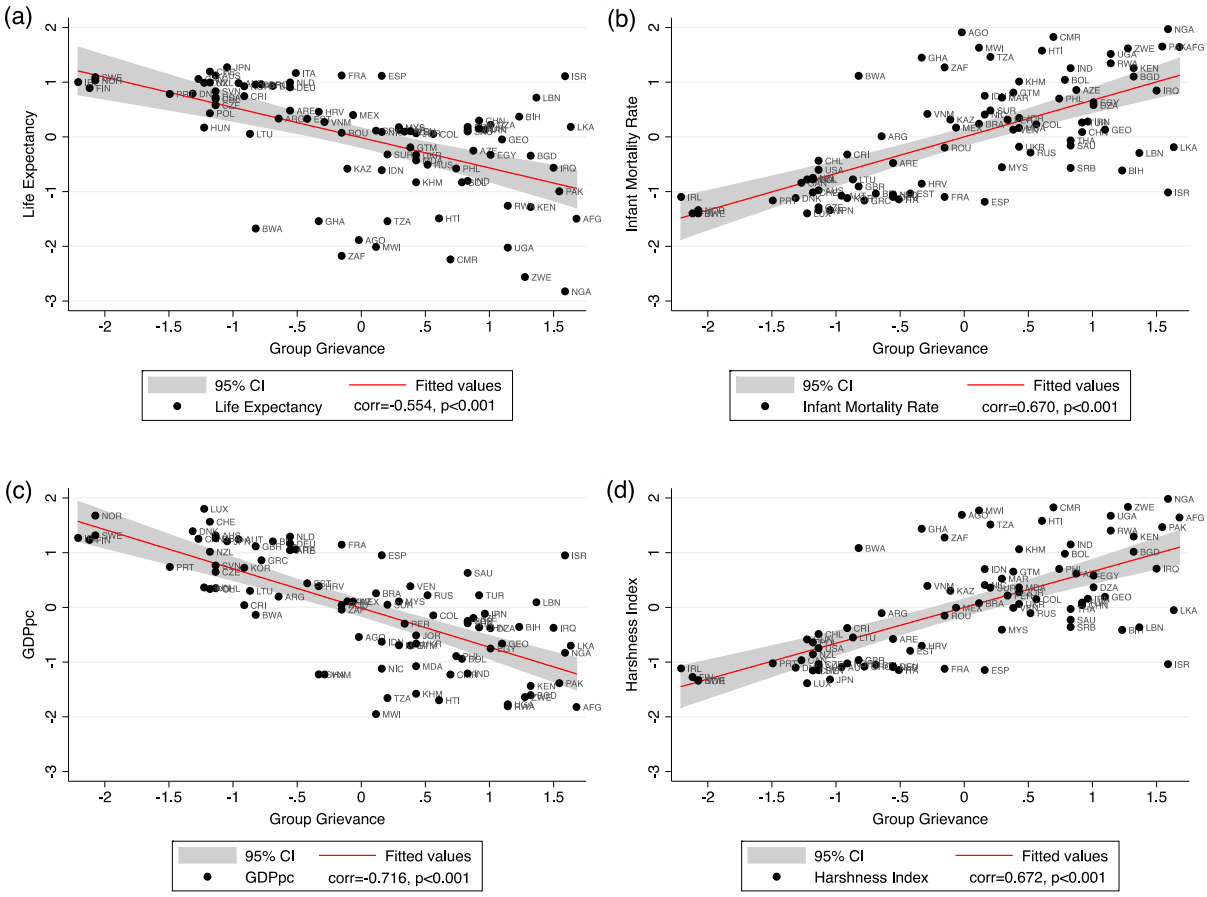


Figure 7*. Linear relationship between Group Grievance and measures of socioecological conditions. (a) Life Expectacy, (b) Infant Mortality, (c) GDPpc, (d) Harshness Index. Correlation coefficients and p-values are displayed in the legend. Grey areas denote 95% confidence intervals. See interactive charts (page 3) on http://bit.ly/worlddistribution*

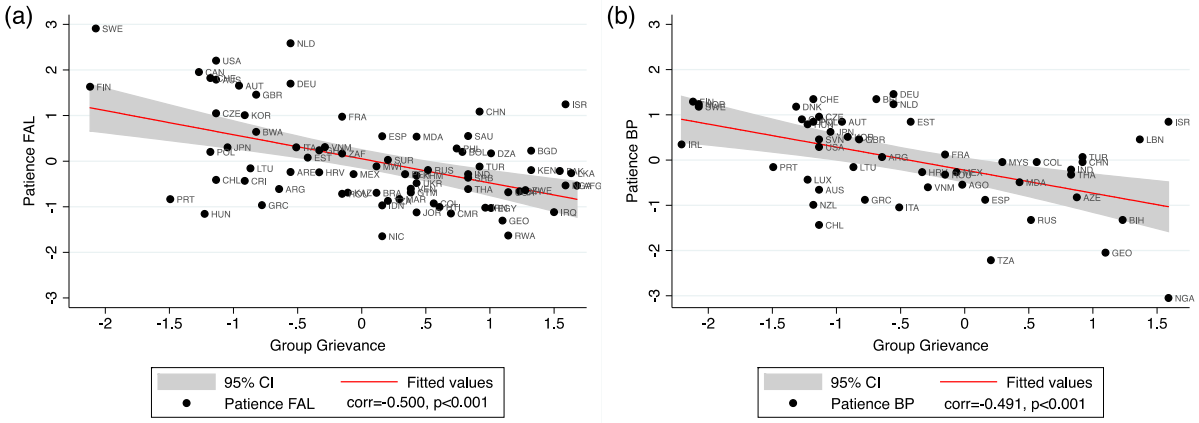
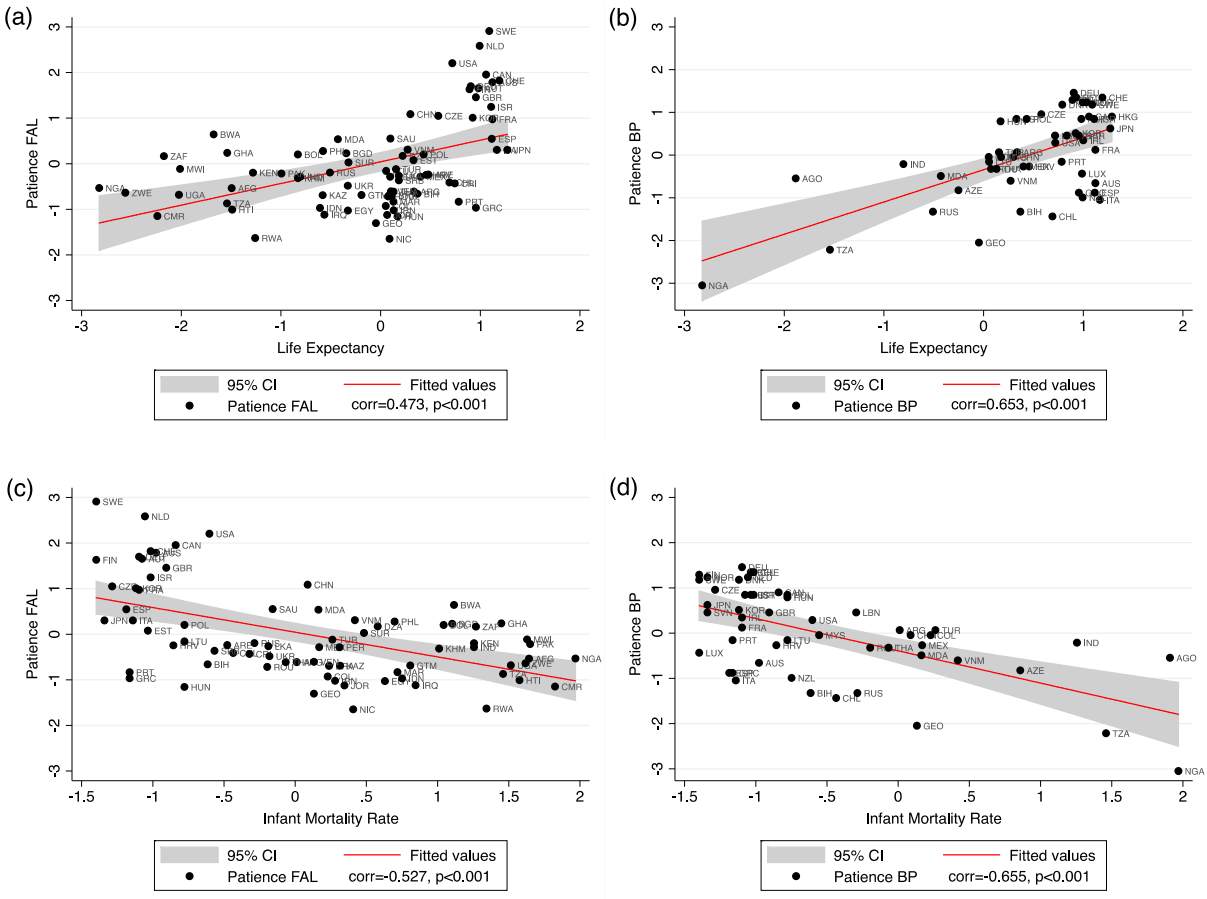


Figure 8. *Linear relationship between Group Grievance and measures of intertemporal choices. (a) Patience FAL, (b) Patience BP. Correlation coefficients and p-values are displayed in the legend. Grey areas denote 95% confidence intervals. See interactive charts (page 3) on http://bit.ly/worlddistribution*



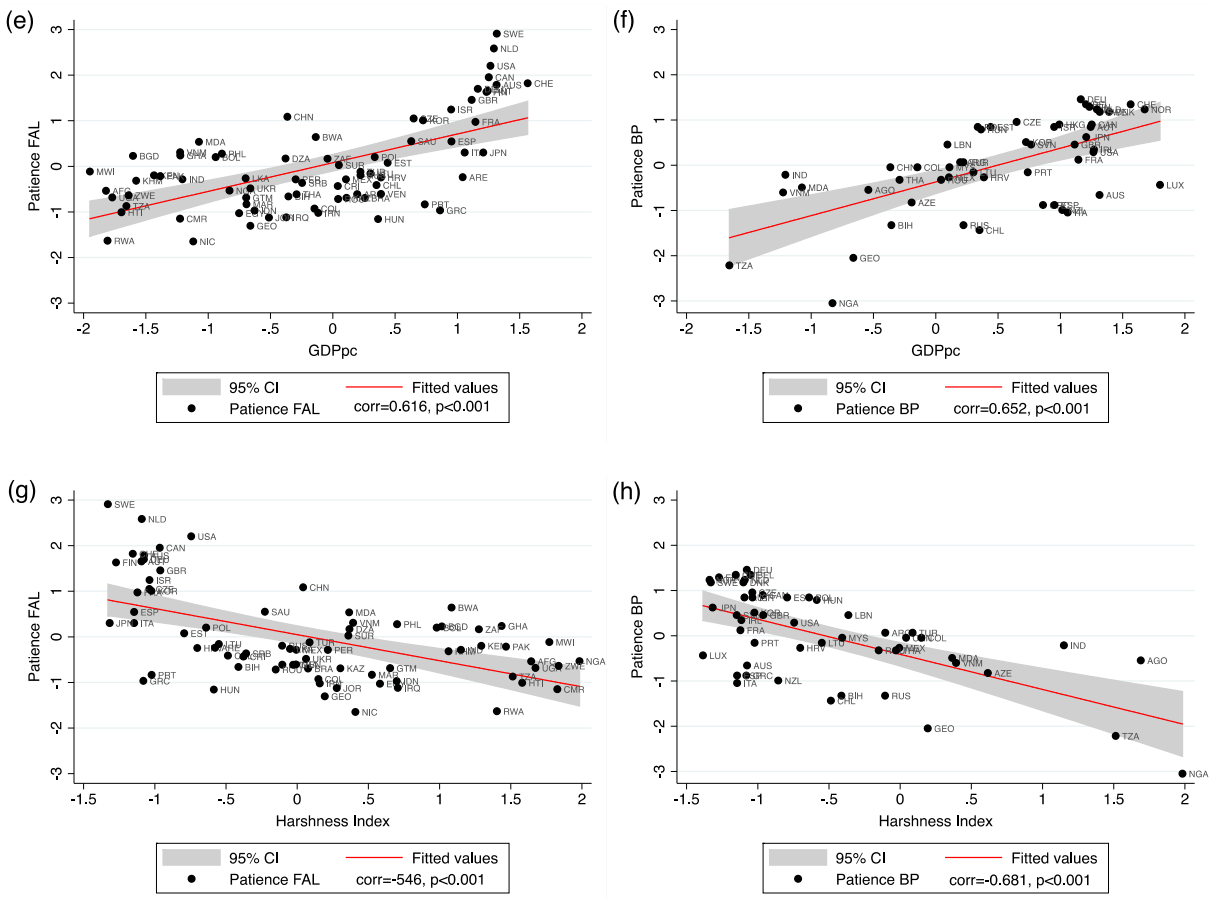


***Figure 9**. Linear relationship between measures of socioecological conditions and measures of intertemporal choices. (a) and (b) for Life Expectancy; (c) and (d) for Infant Mortality Rate; (e) and (f) for GDPpc; (g) and (h) for Harshness Index. (a), (c), (e) and (g) for Patience FAL; (b), (d), (f) and (h) for Patience BP. Correlation coefficients and p-values are displayed in the legend. Grey areas denote 95% confidence intervals. See interactive charts (page 3) on http://bit.ly/worlddistribution*

Structural Equation Models

Initial Model – testing Hypothesis 1

In this section we present the results of the structural equation models used to test *Hypothesis 1*. Specifically, Table 3 shows the estimates for the model in which the socio-ecological conditions of the environment which mediate the relationship between Group Grievance and patience are proxied through Life Expectancy. Tables 4, 5 and 6 do likewise for Infant Mortality Rate, GPD per capita and Harshness Index, respectively, as the measures for environmental conditions. Direct, indirect (mediation) and total effects are reported. In each case, the left-hand column refers to the model without including continent controls, while the right-hand column refers to a model which does include continent dummies to control for possible regional effects on socio-ecological conditions,

which generally reduces the size of the estimated coefficients. The upper part of the tables uses Patience FAL as the final dependent variable while the lower part uses Patience BP.

Table 3. *Structural Equation Models – the impact of intergroup discrimination on DT as mediated by Life Expectancy*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
Life Expectancy	0.286*	0.286*			0.286*	0.286*	76
Group Grievance	-0.344**	-0.344**	-0.155*	-0.09*	-0.500***	-0.434***	76
depvar: Life Expectancy							
Group Grievance	-0.543***	-0.313***			-0.543***	-0.313***	76
depvar: Patience BP							
Life expectancy	0.544***	0.544***			0.544***	0.544***	51
Group Grievance	-0.195+	-0.195+	-0.296*	-0.233**	-0.491***	-0.427***	51
depvar: Life Expectancy							
Group Grievance	-0.545***	-0.428***			-0.545***	-0.428***	51

*Notes: maximum likelihood estimates. Standardized coefficients are reported. Models below the line (Patience BP) have been adjusted for sampling weights. For each effect, the left-hand side column refers to the model without continent fixed effects, whereas the right-hand side column refers to the model with continent fixed effects +p<0.1, *p<0.05, **p<0.01, ***p<0.001*

Below we comment on the findings in tables 3, 4, 5 and 6, subdivided into four types of relationships.

1. Direct effect of Group Grievance on socio-ecological conditions measures. In all cases, the direct effect of Group Grievance on the socio-ecological variables is both statistically and economically significant. More specifically, the effect of Group Grievance on Life Expectancy and GDP per capita is negative while on Infant Mortality Rate and Harshness Index it is positive (all $p<0.001$), independently of whether it is controlled for continent or not, although the inclusion of continent dummies reduces the effect. These results are in line with the first part of *Hypothesis 1* which holds that intergroup discrimination harshens the environmental socio-ecological conditions.

Table 4. *Structural Equation Models – the impact of intergroup discrimination on DT as mediated by Infant Mortality Rate*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
Infant Mortality R.	-0.349**	-0.349**			-0.349**	-0.349**	76
Group Grievance	-0.270*	-0.270*	-0.230**	-0.143**	-0.500***	-0.413***	76
depvar: Infant Mortality Rate							
Group Grievance	0.657***	0.410***			0.657***	0.410***	76
depvar: Patience BP							
Infant Mortality R.	-0.589***	-0.589***			-0.589***	-0.589***	51
Group Grievance	-0.099	-0.099	-0.392**	-0.318***	-0.491***	-0.417***	51
depvar: Infant Mortality Rate							
Group Grievance	0.666***	0.540***			0.666***	0.540***	51

2. Direct effect of environmental conditions on patience. Likewise, replicating previous results and extending them to other environmental conditions measures, harsher environmental conditions are associated with lower patience in all the models (all $p<0.05$). The effects on Patience FAL range from the moderate of Life Expectancy (0.286) to the strong effect of GDP per capita (0.515). The effects on Patience BP are all considerable and very similar, ranging from the 0.544 of Life Expectancy to the 0.637 of the Harshness Index. These results are coherent with the second part of *Hypothesis 1*.

3. Total effect of Group Grievance on patience. In the third place, we observed that the total effects of Group Grievance on patience are always significant and negative independently of whether continents are controlled for (around -0.5 without controls and slightly stronger than -0.4 with controls; all $p<0.01$), as predicted by *Hypothesis 1*.

Table 5. *Structural Equation Models – the impact of intergroup discrimination on DT as mediated by GDPpc*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
GDPpc	0.515***	0.515***			0.515***	0.515***	76
Group Grievance	-0.147	-0.147	-0.352***	-0.252***	-0.500***	-0.400***	76
depvar: GDPpc							
Group Grievance	-0.684***	-0.489***			-0.684***	-0.489***	76
depvar: Patience BP							
GDPpc	0.578***	0.578***			0.578***	0.578**	51
Group Grievance	-0.110	-0.110	-0.381***	-0.318**	-0.491***	-0.428**	51
depvar: GDPpc							
Group Grievance	-0.660***	-0.550***			-0.660***	-0.550***	51

4. Indirect effect (mediated by environmental conditions) of Group Grievance on patience. Finally, the indirect effects were always significant and in the direction indicated by *Hypothesis 1* (all $p<0.05$): a part of the total effect of Group Grievance on patience is mediated by the harshening of the conditions. The variable showing the smallest effect on both patience measures was Life Expectancy, with Group Grievance effects on patience FAL mediated by between 20.73% with continent controls and 31.06% without continent controls, and those on Patience BP mediated between 54.56% and 60.28%, respectively. The strongest mediation on Patience FAL is that reported by GDP per capita (63% and 70.4%, respectively), while for Patience BP is that of the Harshness Index (83.94% and 86.55%, respectively). This strong mediation results in an absence of significance in the direct effect of Group Grievance on patience (i.e., once that occurring through environmental conditions is eliminated), in all cases for Patience BP and in GDP per capita for Patience FAL.

Table 6. *Structural Equation Models – the impact of intergroup discrimination on DT as mediated by Harshness Index*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
Harshness	-0.383**	-0.383**			-0.383**	-0.383**	76
Group Grievance	-0.248*	-0.248*	-0.252**	-0.159**	-0.500***	-0.407***	76
depvar: Harshness							
Group Grievance	0.657***	0.414***			0.657***	0.414***	76
depvar: Patience BP							
Harshness	-0.637***	-0.637***			-0.637***	-0.637***	51
Group Grievance	-0.066	-0.066	-0.425***	-0.345***	-0.491***	-0.411***	51
depvar: Harshness							
Group Grievance	0.667***	0.541***			0.667***	0.541***	51

As such, these results represent clear evidence in favor of *Hypothesis 1* built upon the arguments of Martín et al. (2019): the intergroup discrimination processes modify the TD of individuals through a harshening of the environment, to which they respond by adapting their behavior to prioritize the short-term.

Expanded model – testing Hypothesis 2

In this section we report on the results of the structural equation models designed to test the validity of *Hypothesis 2*, which maintains that ethnic fragmentation causes intergroup discrimination processes which in turn lead to a greater preference for short-term choices due to the harshening of the environment. So as not to overload the analyses in this section, as a proxy for the environmental variables we have used the Harshness Index, which combines Life Expectancy, Infant Mortality Rate and GDP per capita.

Tables 7-12 refer, in this order, to Ethnic Frac AAL, Ethnic Frac MRQ, Ethnic Segregation, Ethnic Polar, Ethnic Ineq ASN and Ethnic Ineq Ethol. With respect to the "Group Grievance-Harshness-Patience" relationship (*Hypothesis 1*) as studied in the previous section, the direct (negative) relationship between Harshness and patience and the direct (positive) relationship between Group Grievance and Harshness were maintained in all the models. Below we present the results for the new relationships proposed under *Hypothesis 2* (see Figure 2).

- **Direct effect of the ethnic fragmentation variables on Group Grievance**. In all cases, the effect was positive and significant, except that of Ethnic Ineq ASN when Patience BP was used as a measure for TD (coeff=0.243, p=0.137). However, the fact that this last relationship was not significant is clearly a composition effect of the Bulley & Pepper (2017) sample of countries, given that in the total sample of 76 countries from Falk et al. (2018) (coeff=0.325), as well as in the total sample of 86 countries represented in Table 2 (coeff=0.332) the relationship between Group Grievance and Ethnic Ineq ASN is significant at 1%, the same as with the rest of the indicators. The strongest direct effect is that of Ethnic Segregation, at 0.556 ($p<0.001$) if we focus on the sample from Falk et al. (2018) which is the largest of the two. These results support the first part of the argument of *Hypothesis 2* for all the ethnic fragmentation measures.
- **Total direct and indirect effect (mediated by Group Grievance) of the ethnic fragmentation variables on the Harshness Index**. All the ethnic fragmentation variables show total effects which are positive and significant or marginally significant on the Harshness Index, except for Ethnic Polar when the continent control is introduced (coeff=0.099, $p>0.2$). In fact, when

controlled for continent the total effects are generally reduced. Basing our results on the broader sample of Falk et al. (2018), the most significant total effects are those of the two ethnic fractionalization measures, Ethnic Frac AAL and Ethnic Frac MRQ, and the Ethnic Segregation measure, with effects between 0.569 and 0.606 without continent controls and between 0.347 and 0.390 when these are introduced (all $p<0.001$). Likewise, all the indirect effects mediated by Group Grievance are significant, except for Ethnic Polar again which only reaches marginal significance (coeff=0.161 without controls, 0.097 with controls; $p<0.07$). The strongest indirect effects are those which measure the relationship of the Harshness Index with Ethnic Segregation (0.321 and 0.200, respectively), Ethnic Frac AAL (0.224 and 0.156) and Ethnic Frac MRQ (0.209 and 0.139) again (all $p<0.01$). These indirect effects represent mediations of between 36% and 58% of the total effect. These results support the argument of *Hypothesis 2* that ethnic fragmentation harshens the environmental conditions through a greater incidence of intergroup discrimination processes. However, the effects do not seem sufficiently robust for the ethnic polarization measure and are especially marked for the segregation and fractionalization measurements, with those of ethnic inequality falling about the middle.

- **Total and indirect effect (mediated by Harshness Index) of the ethnic fragmentation variables on patience.** Here several remarkable discrepancies arise depending on whether Patience FAL or Patience BP is used as the dependent variable. In terms of the models without continent controls, although the relationships are always negative, in line with the predictions of *Hypothesis 2*, only the total effects of the two fractionalization measures and the segregation measure yield a significant effect on Patience FAL, while on Patience BP the fractionalization measurements do not report significant effects and it is those of inequality and, once again, segregation which are significant. However, the effects of the fractionalization measures on Patience BP are similar in size to those observed on Patience FAL, which suggests that the reduction in the number of countries has caused the p-value of these effects to increase (especially in the case of Ethnic Frac MRQ, from 62 to 38 countries, although its effect remains close to the significance). The greatest discrepancy

occurs in relation to the inequality measurements, which do not report significant effects on Patience FAL, while they display the greatest effect on Patience BP. When controlled for continent, some effects are reduced to a large degree (in particular those of the fractionalization measures on Patience BP), with only those of Ethnic Frac AAL and Ethnic Segregation remaining significant or marginally significant on Patience FAL and those of Ethnic Segregation and the two inequality indicators on Patience BP. In terms of the indirect effects on patience mediated by Harshness, all are significant or marginally significant, except that of Ethnic Polar when continents are controlled for. The effects of the variables which report significant total effects are mediated by more than 60% and in some cases up to 100%. This strong mediation means that no significant direct effects remain, once those stemming from socio-ecological conditions are removed, from any of the ethnic fragmentation indicators on either of the two patience measures. In summary, the segregation measure seems to report more robust results while those for fractionalization and inequality are more dependent on the patience measure used and/or the continent controls.

Based on the results from points 1, 2 and 3, the only ethnic fragmentation indicator which, under the two TD measures, complies with the three requirements of *Hypothesis 2* for complete coherence with the relationships envisaged is Ethnic Segregation. On the other hand, those of fractionalization comply with points 1 and 2, and point 3 for Patience FAL but not for Patience BP, especially when controlled for continent. The inequality measures work relatively well when patience BP is used but not when Patience FAL is used, especially for the results of point 3.

Table 7. *Structural Equation Models – the impact of ethnic fractionalization (I) on DT as mediated by intergroup discrimination and harshness conditions*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
Harshness	-0.368**	-0.357**			-0.368**	-0.357**	76
Group Grievance	-0.244+	-0.249+	-0.185***	-0.125***	-0.429***	-0.374**	76
Ethnic Frac AAL	-0.032	-0.033	-0.318***	-0.243***	-0.350***	-0.276*	76
depvar: Harshness							
Group Grievance	0.503***	0.350***			0.503***	0.350***	76
Ethnic Frac AAL	0.346***	0.216**	0.224***	0.156***	0.569***	0.371***	76
depvar: Group Grievance							
Ethnic Frac AAL	0.445***	0.445***			0.445***	0.445***	76
depvar: Patience BP							
Harshness	-0.655***	-0.650***			-0.655***	-0.650***	51
Group Grievance	-0.070	-0.071	-0.367***	-0.347***	-0.437*	-0.417*	51
Ethnic Frac AAL	0.041	0.042	-0.349**	-0.187*	-0.308	-0.146	51
depvar: Harshness							
Group Grievance	0.560***	0.534***			0.560***	0.534***	51
Ethnic Frac AAL	0.277+	0.042	0.215**	0.205*	0.492**	0.246+	51
depvar: Group Grievance							
Ethnic Frac AAL	0.383*	0.383*			0.383*	0.383*	51

Table 8. *Structural Equation Models – the impact of ethnic fractionalization (II) on DT as mediated by intergroup discrimination and harshness conditions*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
Harshness	-0.553***	-0.541***			-0.553***	-0.541***	62
Group Grievance	-0.178	-0.184	-0.289***	-0.188***	-0.467***	-0.372*	62
Ethnic Frac MRQ	0.154	0.159	-0.406***	-0.284***	-0.253*	-0.125	62
depvar: Harshness							
Group Grievance	0.523***	0.347***			0.523***	0.347***	62
Ethnic Frac MRQ	0.397***	0.251***	0.209**	0.139**	0.606***	0.390***	62
depvar: Group Grievance							
Ethnic Frac MRQ	0.399***	0.399***			0.399***	0.399***	62
depvar: Patience BP							
Harshness	-0.685***	-0.678***			-0.685***	-0.678***	38
Group Grievance	0.009	0.009	-0.288*	-0.235*	-0.279	-0.226	38
Ethnic Frac MRQ	0.049	0.049	-0.447**	-0.213+	-0.398+	-0.164	38
depvar: Harshness							
Group Grievance	0.420*	0.347*			0.420*	0.347*	38
Ethnic Frac MRQ	0.448*	0.147	0.211*	0.174*	0.659***	0.321+	38
depvar: Group Grievance							
Ethnic Frac MRQ	0.502***	0.502***			0.502***	0.502***	38

Table 9. *Structural Equation Models – the impact of ethnic segregation on DT as mediated by intergroup discrimination and harshness conditions*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
Harshness	-0.543***	-0.524***			-0.543***	-0.524***	58
Group Grievance	-0.062	-0.063	-0.313***	-0.189***	-0.375*	-0.252	58
Ethnic Segregation	-0.012	-0.012	-0.343***	-0.217**	-0.355**	-0.229+	58
depvar: Harshness							
Group Grievance	0.577***	0.360***			0.577***	0.360***	58
Ethnic Segregation	0.248*	0.147+	0.321***	0.200***	0.569***	0.347***	58
depvar: Group Grievance							
Ethnic Segregation	0.556***	0.556***			0.556***	0.556***	58
depvar: Patience BP							
Harshness	-0.595***	-0.579***			-0.595***	-0.579***	41
Group Grievance	0.077	0.078	-0.320***	-0.268**	-0.243	-0.190	41
Ethnic Segregation	-0.145	-0.146	-0.239**	-0.196*	-0.384*	-0.343+	41
depvar: Harshness							
Group Grievance	0.538***	0.463**			0.538***	0.463**	41
Ethnic Segregation	0.228*	0.199+	0.230*	0.198*	0.458***	0.397**	41
depvar: Group Grievance							
Ethnic Segregation	0.427*	0.427*			0.427*	0.427*	41

Table 10. *Structural Equation Models – the impact of ethnic polarization on DT as mediated by intergroup discrimination and harshness conditions*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
Harshness	-0.451***	-0.423***			-0.451***	-0.423***	61
Group Grievance	-0.179	-0.187	-0.292***	-0.164***	-0.471***	-0.352*	61
Ethnic Polar	-0.009	-0.009	-0.169*	-0.089	-0.178	-0.098	61
depvar: Harshness							
Group Grievance	0.647***	0.388***			0.646***	0.388***	61
Ethnic Polar	0.115	0.002	0.161+	0.097+	0.272*	0.099	61
depvar: Group Grievance							
Ethnic Polar	0.249*	0.249*			0.249*	0.249*	61
depvar: Patience BP							
Harshness	-0.659***	-0.624***			-0.659***	-0.624***	37
Group Grievance	0.007	0.007	-0.418***	-0.262**	-0.412+	-0.255	37
Ethnic Polar	0.025	0.026	-0.174+	-0.086	-0.149	-0.060	37
depvar: Harshness							
Group Grievance	0.635***	0.419**			0.635***	0.419**	37
Ethnic Polar	0.025	-0.019	0.243*	0.161+	0.268+	0.141	37
depvar: Group Grievance							
Ethnic Polar	0.383*	0.383*			0.383*	0.383*	37

Table 11. *Structural Equation Models – the impact of ethnic inequality (I) on DT as mediated by intergroup discrimination and harshness conditions*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
Harshness	-0.432***	-0.415***			-0.432***	-0.415***	75
Group Grievance	-0.240+	-0.247+	-0.247***	-0.170***	-0.487***	-0.417**	75
Ethnic Ineq ASN	0.088	0.091	-0.281***	-0.203**	-0.193+	-0.112	75
depvar: Harshness							
Group Grievance	0.573***	0.409***			0.573***	0.409***	75
Ethnic Ineq ASN	0.285***	0.162*	0.186**	0.133**	0.470***	0.295***	75
depvar: Group Grievance							
Ethnic Ineq ASN	0.325**	0.325**			0.325**	0.325**	75
depvar: Patience BP							
Harshness	-0.578***	-0.564***			-0.578***	-0.564***	51
Group Grievance	-0.074	-0.075	-0.348***	-0.306***	-0.421**	-0.381*	51
Ethnic Ineq ASN	-0.131	-0.133	-0.257*	-0.155*	-0.389**	-0.288*	51
depvar: Harshness							
Group Grievance	0.602***	0.543***			0.602***	0.543***	51
Ethnic Ineq ASN	0.268*	0.111	0.146	0.132	0.415**	0.243*	51
depvar: Group Grievance							
Ethnic Ineq ASN	0.243	0.243			0.243	0.243	51

Table 12. *Structural Equation Models – the impact of ethnic inequality (II) on DT as mediated by intergroup discrimination and harshness conditions*

	Direct effects		Indirect effects		Total effects		Countries
	No cont. Control	Cont. Control	No cont. Control	Cont. Control	No cont. Control	Cont. Control	
depvar: Patience FAL							
Harshness	-0.467***	-0.450***			-0.467***	-0.450***	75
Group Grievance	-0.230+	-0.237+	-0.264***	-0.185***	-0.493***	-0.422***	75
Ethnic Ineq Ethnol	0.139	0.143	-0.304***	-0.206**	-0.165	-0.063	75
depvar: Harshness							
Group Grievance	0.565***	0.410***			0.565***	0.410***	75
Ethnic Ineq Ethnol	0.333***	0.177*	0.170*	0.123*	0.503***	0.300***	75
depvar: Group Grievance							
Ethnic Ineq Ethnol	0.301**	0.301**			0.301**	0.301**	75
depvar: Patience BP							
Harshness	-0.584***	-0.576***			-0.584***	-0.576***	51
Group Grievance	-0.071	-0.072	-0.327***	-0.299***	-0.398*	-0.371*	51
Ethnic Ineq Ethnol	-0.097	-0.098	-0.324**	-0.196*	-0.421**	-0.294*	51
depvar: Harshness							
Group Grievance	0.560***	0.520***			0.560***	0.520***	51
Ethnic Ineq Ethnol	0.341**	0.139	0.176*	0.163*	0.517***	0.302*	51
depvar: Group Grievance							
Ethnic Ineq Ethnol	0.314*	0.314*			0.314*	0.314*	51

4.4 Discussion

Based on structural equation modelling, our results show a strong relationship between a proxy for country-level intergroup discrimination (i.e., Group Grievance index) and the average TD of a country's inhabitants, which is partially mediated by the socio-ecological conditions in the country. This finding is robust to different statistical specifications, and to two different datasets and measures of TD. That is, in accordance with our *Hypothesis 1*, built upon Martin et al.'s (2019) arguments, intergroup discrimination processes may trigger harsh environmental conditions (or perceived as so) which, in turn, make individuals to adaptively respond by focusing on the short-run vs. the long-run.

These findings suggest that the evolutionary perspective of Life History Theory can be very helpful in understanding the roots of individual differences in TD. According to this perspective, discounting the future heavily is not necessarily considered a maladaptive behavior but might be a contextually appropriate response to environmental cues of harshness which encourage fast (vs. slow) Life History strategies. Phenotypic plasticity works in this way to maximize the lifetime inclusive fitness of the individual through its adaptation to the socio-ecological conditions. Preferences, similarly to other traits, are therefore considered endogenous, rather than exogenous as assumed in the vast majority of economic models. In particular, in environments where there are cues signaling a high risk of mortality for oneself or one's offspring and scarcity of material resources, individuals should respond adaptatively by discounting future rewards heavily (Daly & Wilson 2005, Frankenhuis et al. 2016, Pepper & Nettle 2017). Adding to previous work, the current results show that a link between harsh socio-ecological conditions and impatience (i.e., high TD) exists not only when the former are proxied by Life Expectancy as in Bulley & Pepper (2017) and Lee et al. (2018), or GDP per capita as in Dohmen et al. (2018), but also when harshness is proxied by infant mortality rate, which had not been explored so far (to the best of our knowledge). Moreover, we show that the existence of intergroup discrimination processes is a potential source of environmental harshness, according to the three measures used.

Intergroup discrimination is inherent to the human social psychology (Tajfel 1974, De Cremer & Van Vugt 1999). In many situations, people act more prosocially towards members of their own groups compared to members of other groups, thus showing

ingroup favoritism and often even outgroup hatred (Brewer 1999, Espín et al. 2016, Baillet et al. 2014, Buttelmann & Böhm 2014). How "groups" are defined is a matter of identity: people tend to identify with their group based on any shared characteristic that differentiate its members from the members of other groups. This may eventually drive the individual's own interest to (at least subjectively) align with the group's interest, thus promoting ingroup prosociality (Tajfel 1974). Intergroup processes, especially competition between groups, is indeed theorized as a likely mechanism underlying the evolution of human large-scale cooperation: under some conditions, those groups formed by more selfish individuals are outcompeted by groups with more cooperative members and, hence, prosocial traits can survive and expand to the whole population (Sober & Wilson 1998, Henrich 2004, Nowak 2006, Richerson et al. 2016). However, intergroup competition may have a dark side since outgroup hatred very often leads to between-group spitefulness and socially-inefficient outcomes (e.g., Bernhard et al. 2006, Abbink et al. 2010, Espín et al. 2016). Our results suggest that the impact of intergroup processes on societal outcomes may also have further long-lasting effects, not considered previously in the literature, through their impact on individuals' TD. A related strand of research has shown that individuals who have been more exposed to violent conflicts discount the future more heavily (Voors et al. 2012, Imas et al. 2018). Assuming the existence of a connection between intergroup discrimination and violent conflict (see below for a discussion on this relationship, in particular, for the case of civil wars), our findings would also be consistent with that evidence. We however add a Life History evolutionary perspective by hypothesizing, and identifying, environmental harshness as a variable mediating such relationship.

One of the primary sources of group identification and, consequently, intergroup discrimination is ethnicity (Levine & Campbell 1972). In our exploratory *Hypothesis 2*, we set up ethnic fragmentation, broadly understood, as a potential reason underlying intergroup discrimination processes in a given country and ultimately the TD of its inhabitants. To test this hypothesis (which is more accurately described as a set of hypotheses), we introduce four factors related to ethnic fragmentation – i.e., ethnic fractionalization, segregation, polarization and inequality –, each defining a different fragmentation-related concept and using a distinct measurement approach. The results are not as conclusive here as for *Hypothesis 1* but they nonetheless offer interesting insights.

First, ethnic (spatial) segregation is the fragmentation measure that fits best into the predictions of *Hypothesis 2*, considering both TD measures together. Ethnic segregation is also the measure displaying the strongest correlation with Group Grievance. These results suggest that the incorporation of territorial issues into identity categorizations strongly spur intergroup discrimination and this ends up in increasing the individuals' TD. Ethnic segregation has been identified as a potential source for low institutional quality and institutional failure (Alesina & Zhuravskaya 2011). Whether the impact of ethnic segregation on environmental harshness flows through institutional failure is a matter for future research. It is also true, however, that ethnic segregation is the fragmentation measure which can most reasonably be both an effect and a cause of intergroup discrimination. That is, the relationship between ethnic segregation and Group Grievance may perfectly be bi-directional, with territorial issues amplifying interethnic conflict and interethnic conflict encouraging the physical isolation of ethnic groups (see below for a deeper discussion on causality concerns as a limiting factor of this study).

Second, ethnic polarization does a rather poor job in predicting both environmental harshness and average individual TD, regardless of the TD measure used. This apparently contrasts with the observation of Montalvo & Reynal-Querol (2005b) that the incidence of civil wars increases more with the countries' ethnic polarization than with other measures such as ethnic fractionalization. Note that polarization is typically high when there is a large ethnic minority and, following the latter authors, this is a powerful driving force behind extreme violent conflicts like civil wars. But according to our results, ethnic polarization does not spur environmental harshness (through intergroup discrimination processes) as strongly as other factors, including fractionalization – which is typically high when there exist many small ethnic groups in the country. Combining our findings with those of Montalvo & Reynal-Querol (2005b), we can speculate that the incidence of civil wars may have little to do with enduring, generalized intergroup discrimination processes that increase environmental harshness in a scale able to allow individual trait adaptation. Furthermore, it might be that intergroup discrimination primarily increases the TD of the individuals belonging to groups discriminated against (Martín et al 2019). This would explain why the existence of a large minority predicts (high) average TD in a country less accurately than the existence of many small ethnic groups, in particular if those groups represent more than half of the population and all feel discriminated against

(compared to a large minority which by definition represents less than half of the population).

Finally, ethnic fractionalization and ethnic (welfare) inequality show extremely different predictive power over TD depending on whether TD is evaluated using the measure of Falk et al. (2018) or that of Bulley & Pepper (2017). Since the samples differ between the two measures, it might be that the different countries composition drives the difference. However, using the 40 countries included in both datasets we find very similar results: ethnic fractionalization predicts relatively well the patience measure of Falk et al. (2018) but not that of Bulley & Pepper (2017), whereas the opposite is true for ethnic inequality. We can thus conclude that the observed differences do not seem to stand from differences in sample composition (the statistical weights used for the Bulley & Pepper 2017 sample are not the reason either). There exist, however, at least two other potential ways in which such differences may arise. On the one hand, the samples are representative of the countries' population in Falk et al. (2018), whereas university student samples are used in Bulley & Pepper (2017). One might speculate that cross-country differences in the TD of university students (vs. the general population) is more affected by ethnic inequality than by ethnic fractionalization (and vice versa), probably related to the fact that students' have relatively high socio-economic status. On the other hand, the TD measure of Falk et al. (2018) employs choices between rewards to be received either "today" or "in one year", whereas Bulley & Pepper (2017) asks for choices between "this month" and "next month". This implies that, according to the widely-used model of quasi-hyperbolic TD (Laibson 1997), the former obtains a measure that combines both short-run discounting, or present bias, and long-run discounting into a single TD value, whereas the latter only measures long-run discounting because there is no immediate-reward option. It might be the case that ethnic fractionalization impacts more on the present bias component of individuals' TD while ethnic inequality impacts more on its long-run component. Further research should examine these possibilities in greater detail.

Our results also have implications for the relationship between ethnic fragmentation and environmental harshness. Previous studies have documented a (negative) link between ethnon-linguistic fragmentation and various aspects of economic performance (reviewed in Alesina & La Ferrara 2005; see also Alesina et al. 2016 for more recent evidence). Note that, except for ethnic polarization (which, in any case, shows the weakest

correlation with all the three environmental conditions variables; correlations ranging from 0.23 to 0.33), all the other five ethnic fragmentation measures used here tend to correlate more strongly with Life Expectancy (correlations ranging from 0.45 to 0.60) and, especially, infant mortality rate (0.51-0.64) than with GDP per capita (0.42-0.55, see Table 2). This observation may suggest that the extensively-discussed effects of ethnic fragmentation on economic performance should be seen more broadly as effects on the environment's harshness conditions rather than on purely economic variables. This argument deserves further exploration though.

The present study, nevertheless, has several limitations. The main limitation is arguably related to the cross-section nature of the data. Although our results give considerable support to the hypothesized causal relationships, longitudinal studies in which the TD of the countries' inhabitants is assessed repeatedly over time are required to draw firmer conclusions about causality. Note that methods such as lagging the effect of the explanatory variables is not enough to get rid, for instance, of potential omitted-variable concerns. Along these lines, using data from Falk et al. (2018) and an overlapping-generations theoretical model, Dohmen et al. (2018) convincingly argue that individuals' patience drives, at least partially, the accumulation of physical and human capital and productivity improvements, and hence higher average patience in a country increases its GDP pc through higher growth rates. Similarly, to the extent that more impatient individuals tend to engage in more risky and unhealthy behaviors – e.g. aggression and drug abuse (Barkley et al. 2001, Bickel & Marsch 2001, Espín et al. 2012, 2015) –, it might be that individual impatience is a cause of aggregate-level environmental harshness (particularly, mortality risk) rather than, or in addition to, being one of its consequences (Lee et al. 2018). Similarly applies to the link of Group Grievance with both socio-ecological conditions and TD: impatient individuals may be more prone to intergroup discrimination (see Espín et al. 2016) and harsh conditions may potentiate intergroup discrimination processes. While these are valid concerns, the existence of potential sources of reverse causality, however, does not discredit the validity of the causal relationships hypothesized here. Further research is warranted to shed more light on this issue.

A second limitation hinges upon the aggregate nature of the TD data used. Next steps include the use of multilevel regression analyses in order to be able to control for

individual-level variables potentially related to discounting, such as socio-economic status, age or gender, which can act as confounding factors (Martín et al. 2019).

Finally, both TD measures are based on choices over hypothetical rather than real rewards. Although the literature tends to favor the interpretation that choices over hypothetical rewards accurately reflect choices over real rewards (e.g. Bickel et al. 2009, Johnson & Bickel 2002, Lagorio & Madden 2005, but see Coller & Williams 1999), and the Falk et al.'s (2018) measure has even been validated using typical experimental economics TD tasks with real incentives, future research should try to have individuals making real decisions in cross-country evaluations of TD. This should lead to more ecologically-valid measurements.

In sum, our research demonstrates the soundness of using a Life History lens to study individual differences in TD. The integration into a comprehensive account of TD of adaptationist arguments focusing on the endogeneity and context-dependence of psychological traits with views, more traditional in the social sciences (especially in economics), according to which it is individuals' (exogenously determined) preferences that can modify the environment, is a promising avenue for future theoretical and empirical research.

References

Abbink, K., Brandts, J., Herrmann, B., & Orzen, H. (2010). Intergroup conflict and intra-group punishment in an experimental contest game. *American Economic Review*, *100*(1), 420-47.

Ainslie, G. (1975). Specious reward: a behavioral theory of impulsiveness and impulse control. *Psychological bulletin*, *82*(4), 463.

Alesina A, & Zhuravskaya E. (2011). Segregation and the Quality of Government in a Cross-Section of Countries. *American Economic Review*. ;101(5):1872–1911.

Alesina, A., & Ferrara, E. L. (2005). Ethnic diversity and economic performance. *Journal of economic literature*, *43*(3), 762-800.

Alesina, A., Baqir, R., & Easterly, W. (1999). Public goods and ethnic divisions. *The Quarterly Journal of Economics*, *114*(4), 1243-1284.

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., & Wacziarg, R. (2003). Fractionalization. *Journal of Economic growth*, *8*(2), 155-194.

Alesina, A., Michalopoulos, S., & Papaioannou, E. (2016). Ethnic inequality. *Journal of Political Economy*, *124*(2), 428-488.

Anokhin, A. P., Golosheykin, S., Grant, J. D., & Heath, A. C. (2011). Heritability of delay discounting in adolescence: a longitudinal twin study. *Behavior genetics*, *41*(2), 175-183.

Atlas Narodov Mira (Atlas of the People of the World). Moscow: Glavnoe Upravlenie Geodezii i KartograÖi, 1964.Bruck, S.I., and V.S. Apenchenko (eds.).

Aycinena, D., & Rentschler, L. (2018). Discounting and digit ratio: Low 2D: 4D predicts patience for a sample of females. *Frontiers in behavioral neuroscience*, *11*, 257.

Balliet, D., Wu, J., & De Dreu, C. K. (2014). Ingroup favoritism in cooperation: a meta-analysis. *Psychological Bulletin*, *140*(6), 1556.

Barkley, R. A., Edwards, G., Laneri, M., Fletcher, K., & Metevia, L. (2001). Executive functioning, temporal discounting, and sense of time in adolescents with attention deficit

hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD). *Journal of abnormal child psychology*, *29*(6), 541-556.

Becker, G. S., & Mulligan, C. B. (1997). The endogenous determination of time preference. *The Quarterly Journal of Economics*, *112*(3), 729-758.

Belsky, J., Schlomer, G. L., & Ellis, B. J. (2012). Beyond cumulative risk: Distinguishing harshness and unpredictability as determinants of parenting and early life history strategy. *Developmental psychology*, *48*(3), 662.

Bernhard, H., Fischbacher, U., and Fehr, E. (2006). Parochial altruism in humans. *Nature* 442, 912–915.

Bevilacqua, L., & Goldman, D. (2013). Genetics of impulsive behavior. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *368*(1615), 20120380.

Bickel, W. K., & Marsch, L. A. (2001). Toward a behavioral economic understanding of drug dependence: delay discounting processes. *Addiction*, *96*(1), 73-86.

Bickel, W.K., Pitcock, J.A., Yi, R., & Angtuaco, E.J. (2009). Congruence of BOLD response 810 across intertemporal choice conditions: fictive and real money gains and losses. The 811 Journal of Neuroscience, 29, 8839–8846.

Boyd, R., & Richerson, P. J. (1988). *Culture and the evolutionary process*. University of Chicago press.

Brewer,M.B. (1999).The psychology of prejudice: Ingroup love and outgroup hate?. Journal of 823Social Issues,55(3), 429-444.

Brumbach, B. H., Figueredo, A. J., & Ellis, B. J. (2009). Effects of harsh and unpredictable environments in adolescence on development of life history strategies. *Human Nature*, *20*(1), 25-51.

Bulley, A., & Pepper, G. V. (2017). Cross-country relationships between life expectancy, intertemporal choice and age at first birth. *Evolution and Human Behavior*, *38*(5), 652-658.

Buttelmann, D., & Böhm, R. (2014). The ontogeny of the motivation that underlies in-group bias. *Psychological Science*, *25*(4), 921-927.

Central Intelligence Agency. (2000). CIAWorld Factbook. Washington, DC: CIA Office of Public Affairs.

Coller, M., & Williams, M. B. (1999). Eliciting individual discount rates. *Experimental Economics*, *2*(2), 107-127.

Cornsweet, T. N. (1962). The staircase-method in psychophysics. *The American journal of psychology*, *75*(3), 485-491.

Curry, O. S., Price, M. E., & Price, J. G. (2008). Patience is a virtue: Cooperative people have lower discount rates. *Personality and individual differences*, *44*(3), 780-785.

Daly, M., & Wilson, M. (2005). Carpe diem: Adaptation and devaluing the future. *The quarterly review of Biology*, *80*(1), 55-60.

De Cremer, D., & Van Vugt, M.(1999).Social identification effects in social dilemmas. European Journal of Social Psychology,29(7), 871-93

del Giudice, M. D., Gangestad, S. W., & Kaplan, H. S. (2015). Life history theory and evolutionary psychology. *The handbook of evolutionary psychology*, 1-27.

Dickins, T. E., Johns, S. E., & Chipman, A. (2012). Teenage pregnancy in the United Kingdom: A behavioral ecological perspective. *Journal of Social, Evolutionary, and Cultural Psychology*, *6*(3), 344.

Dohmen, T., Enke, B., Falk, A., Huffman, D., & Sunde, U. (2018). *Patience and comparative development*. Mimeo.

Easterly, W., & Levine, R. (1997). Africa's growth tragedy: policies and ethnic divisions. *The quarterly journal of economics*, *112*(4), 1203-1250.

Ellis, B. J., Figueredo, A. J., Brumbach, B. H., & Schlomer, G. L. (2009). Fundamental dimensions of environmental risk. *Human Nature*, *20*(2), 204-268.

Encyclopedia Britannica (2000). Chicago: Encyclopedia Britannica.

Espín, A. and Correa, M. and Ruiz-Villaverde, A. (2016). Patience Predicts Cooperative Synergy: The Roles of Ingroup Bias and Reciprocity. Available at SSRN: https://ssrn.com/abstract=2596837

Espín, A. M., Brañas-Garza, P., Herrmann, B., & Gamella, J. F. (2012). Patient and impatient punishers of free-riders. *Proc. R. Soc. B*, rspb20122043.

Espín, A. M., Exadaktylos, F., Herrmann, B., & Brañas-Garza, P. (2015). Short-and long-run goals in ultimatum bargaining: impatience predicts spite-based behavior. *Frontiers in Behavioral Neuroscience*, *9*, 214.

Espín, A., Sánchez, A., & Herrmann, B. (2017). Economic preferences 2.0: Connecting competition, cooperation and inter-temporal preferences. *CEDEX Discussion Papers, No. 2017-04*.

Falk, A., Becker, A., Dohmen, T., Enke, B., Huffman, D., & Sunde, U. (2018). Global evidence on economic preferences. *The Quarterly Journal of Economics*, *133*(4), 1645-1692., https://doi.org/10.1093/qje/qjy013.

Falk, A., Becker, A., Dohmen, T., Huffman, D., & Sunde, U. (2016). The preference survey module: A validated instrument for measuring risk, time, and social preferences. *Netspar Discussion Paper No. 01/2016-003*

Frankenhuis, W. E., Panchanathan, K., & Nettle, D. (2016). Cognition in harsh and unpredictable environments. *Current Opinion in Psychology*, *7*, 76-80.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic perspectives*, *19*(4), 25-42

Frederick, S., Loewenstein, G., & O'donoghue, T. (2002). Time discounting and time preference: A critical review. *Journal of economic literature*, *40*(2), 351-401.

FSI (2018). Fragile state index. http://fsi.fundforpeace.org/. Accessed Jul 2018.

Gächter, S. (2010). (Dis) advantages of student subjects: what is your research question?. *Behavioral and brain sciences*, *33*(2-3), 92-93.

Gordon RG. Ethnologue: Languages of the World 2005

Griskevicius, V., Tybur, J. M., Delton, A. W., & Robertson, T. E. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: a life history theory approach. *Journal of personality and social psychology*, *100*(6), 1015.

Harrison, G. W., Lau, M. I., & Williams, M. B. (2002). Estimating individual discount rates in Denmark: A field experiment. *American economic review*, *92*(5), 1606-1617.

Henderson VJ, Storeygard A, Weil DN. (2012). Measuring Economic Growth from Outer Space. *American Economic Review*. 102(2):994–1028.

Henrich, J. (2004). Cultural group selection, coevolutionary processes and large-scale cooperation. *Journal of Economic Behavior & Organization*, *53*(1), 3-35.

Herrmann, B., Thöni, C., & Gächter, S. (2008). Antisocial punishment across societies. *Science*, *319*(5868), 1362-1367.

Hill, E. M., Jenkins, J., & Farmer, L. (2008). Family unpredictability, future discounting, and risk taking. *The Journal of Socio-Economics*, *37*(4), 1381-1396.

Imas, A., Kuhn, M. A., & Mironova, V. (2018). Exposure to Violence Predicts Impulsivity in Time Preference: Evidence from The Democratic Republic of Congo.

Johns, S. E., Dickins, T. E., & Clegg, H. T. (2011). Teenage pregnancy and motherhood: How might evolutionary theory inform policy?. *Journal of Evolutionary Psychology*, *9*(1), 3-19.

Johnson, M.W., & Bickel, W.K. (2002). Within-subject comparison of real and hypothetical 904 money rewards in delay discounting. Journal of the Experimental Analysis of Behavior, 905 77, 129–146.

Kable, J. W., & Glimcher, P. W. (2007). The neural correlates of subjective value during intertemporal choice. *Nature neuroscience*, *10*(12), 1625.

Kaplan, H. S., & Gangestad, S. W. (2005). Life history theory and evolutionary psychology. *The Handbook of Evolutionary Psychology*, 68-95.

Kidd, C., Palmeri, H., & Aslin, R. N. (2013). Rational snacking: Young children's decision-making on the marshmallow task is moderated by beliefs about environmental reliability. *Cognition*, *126*(1), 109-114.

Kirby, K. N. (2009). One-year temporal stability of delay-discount rates. *Psychonomic bulletin & review*, *16*(3), 457-462.

Kirby, K. N., & Maraković, N. N. (1996). Delay-discounting probabilistic rewards: Rates decrease as amounts increase. *Psychonomic bulletin & review*, *3*(1), 100-104.

Kirby, K. N., Godoy, R., Reyes-Garcıa, V., Byron, E., Apaza, L., Leonard, W., ... & Wilkie, D. (2002). Correlates of delay-discount rates: Evidence from Tsimane'Amerindians of the Bolivian rain forest. *Journal of Economic Psychology*, *23*(3), 291-316.

Lagorio, C.H., & Madden, G.J. (2005). Delay discounting of real and hypothetical rewards III: 928 Steady-state assessments, forced-choice trials, and all real rewards. Behavioral 929 Processes, 69, 173–187.

Laibson, D. (1997). Golden eggs and hyperbolic discounting. *The Quarterly Journal of Economics*, *112*(2), 443-478.

Lee, A. J., DeBruine, L. M., & Jones, B. C. (2018). Individual-specific mortality is associated with how individuals evaluate future discounting decisions. *Proc. R. Soc. B*, *285*(1880), 20180304.

Levine, R. A., and Campbell, D. T. (1972). *Ethnocentrism: Theories of Conflict, Ethnic Attitudes, and Group Behavior*. New York, NY: Wiley.

Levinson, D. (1998). Ethnic Groups Worldwide, A Ready Reference Handbook. Phoenix: Oryx Press.

Lumsden, C. J., & Wilson, E. O. (1981). *Genes, mind, and culture: The coevolutionary process*. Harvard University Press.

Martín, J., Brañas-Garza, P., Espín, A. M., Gamella, J. F., & Herrmann, B. (2019). The appropriate response of Spanish *Gitanos*: Short-run orientation beyond current socio-economic status. *Evolution and Human Behavior*, *40*(1), 12-22.

McClure, S. M., Laibson, D. I., Loewenstein, G., & Cohen, J. D. (2004). Separate neural systems value immediate and delayed monetary rewards. *Science*, *306*(5695), 503-507.

Meier, S., & Sprenger, C. D. (2012). Time discounting predicts creditworthiness. *Psychological science*, *23*(1), 56-58.

Minority Rights Group International. (1997). World Directory of Minorities. London: Minority Rights Group International.

Montalvo, J. G., & Reynal-Querol, M. (2005a). Ethnic diversity and economic development. *Journal of Development economics*, *76*(2), 293-323.

Montalvo, J. G., & Reynal-Querol, M. (2005b). Ethnic polarization, potential conflict, and civil wars. *American economic review*, *95*(3), 796-816

Nowak, M. A. (2006). Five rules for the evolution of cooperation. *science*, *314*(5805), 1560-1563.

Ohmura, Y., Takahashi, T., Kitamura, N., & Wehr, P. (2006). Three-month stability of delay and probability discounting measures. *Experimental and clinical psychopharmacology*, *14*(3), 318.

Pepper, G. V., & Nettle, D. (2017). The behavioral constellation of deprivation: causes and consequences. *Behavioral and Brain Sciences*, *40*.

Rachlin, H., & Green, L. (1972). Commitment, choice and self-control 1. *Journal of the experimental analysis of behavior*, *17*(1), 15-22.

Ramos, D., Victor, T., Seidl-de-Moura, M. L., & Daly, M. (2013). Future discounting by slum-dwelling youth versus university students in Rio de Janeiro. *Journal of Research on Adolescence*, *23*(1), 95-102.

Read, D., & Van Leeuwen, B. (1998). Predicting hunger: The effects of appetite and delay on choice. *Organizational behavior and human decision processes*, *76*(2), 189-205.

Reardon, S. F., & Firebaugh, G. (2002). Measures of multigroup segregation. *Sociological methodology*, *32*(1), 33-67.

Richerson, P., Baldini, R., Bell, A. V., Demps, K., Frost, K., Hillis, V., ... & Ross, C. (2016). Cultural group selection plays an essential role in explaining human cooperation: A sketch of the evidence. *Behavioral and Brain Sciences*, *39*.

Rieger, M. O., Wang, M., & Hens, T. (2014). Risk preferences around the world. *Management Science*, *61*(3), 637-648.

Roff, 1993. D. Roff (Ed.), Evolution of life histories: Theory and analysis, Chapman & Hall, New York (1993)

Sen, A. (1992). *Inequality reexamined*. Clarendon Press.

Sober, E., & Wilson, D. S. (1999). *Unto others: The evolution and psychology of unselfish behavior* (No. 218). Harvard University Press.

Sober, E., & Wilson, D. S. (2011). Adaptation and natural selection revisited. *Journal of evolutionary biology*, *24*(2), 462-468.

Story, G., Vlaev, I., Seymour, B., Darzi, A., & Dolan, R. (2014). Does temporal discounting explain unhealthy behavior? A systematic review and reinforcement learning perspective. *Frontiers in behavioral neuroscience*, *8*, 76.

Tajfel, H. (1974). Social identity and intergroup behavior. *Information (International Social Science Council)*, *13*(2), 65-93.

Tajfel, H., Turner, J. C., Austin, W.G., & Worchel, S. (1979). An integrative theory of intergroup conflict. *Organizational identity: A reader*, 56-65.

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and time preferences: Linking experimental and household survey data from Vietnam. *American Economic Review*, *100*(1), 557-71.

Voors, M. J., Nillesen, E. E., Verwimp, P., Bulte, E. H., Lensink, R., & Van Soest, D. P. (2012). Violent conflict and behavior: a field experiment in Burundi. *American Economic Review*, *102*(2), 941-64.

Wang, M., Rieger, M. O., & Hens, T. (2016). How time preferences differ: Evidence from 53 countries. *Journal of Economic Psychology*, *52*, 115-135

Weidmann NB, Rod JK, Cederman L-E. (2010).Representing Ethnic Groups in Space: A New Dataset. *Journal of Peace Research*. ;47(4):491–499

Capítulo 5: Conclusiones

5 Conclusiones

Comportamiento social para la provisión de bienes públicos

Nuestros experimentos arrojan luz sobre las raíces evolutivas del comportamiento prosocial humano y el castigo altruista en particular, poniendo de manifiesto el efecto de los procesos intergrupales sobre la conducta. En el capítulo 2, la sección *Dicussion* discute extensamente los resultados y aporta una serie de conclusiones detalladas. A continuación, simplemente se enumeran las principales conclusiones en este sentido y se remite al lector al mencionado capítulo para una mayor profundidad de análisis:

1. La hipótesis del "Gran Error" o "Desajuste" prescribe que los Gitanos deberían castigar de manera similar o un poco más firmemente que los no-Gitanos en promedio porque, aunque también son humanos "modernos" su organización social se basa más en el parentesco, las redes familiares y la cercanía. La explicación sería que el castigo altruista habría evolucionado en grupos humanos ancestrales de pequeña escala mediante la selección por parentesco y/o mecanismos de reciprocidad "tradicionales", dado que otorgaba beneficios materiales o reproductivos al castigador. Dicha psicología evolucionada debería ser mostrada de igual manera o de forma más clara por los Gitanos que todavía están muy organizados en torno al parentesco y las relaciones cercanas, en contraste con los no-Gitanos que tienen encuentros esporádicos más frecuentes con desconocidos. Nuestros resultados no apoyan esta predicción. El uso del castigo por parte de los Gitanos en grupos homogéneos era casi inexistente, especialmente en comparación con el de los no-Gitanos.
2. Si el castigo altruista es particularmente importante para la cooperación entre desconocidos en las sociedades a gran escala, como sostienen los teóricos de la selección de grupos culturales, sin embargo, los no-Gitanos deberían castigar más que los Gitanos en grupos homogéneos. Efectivamente, en nuestros

experimentos los no-Gitanos hacían mayor uso del mecanismo de castigo que los Gitanos.

3. A diferencia de las predicciones de la hipótesis del "Gran Error", la existencia de procesos de selección cultural predice diferentes manifestaciones de la misma conducta (en este caso, el castigo hacia los miembros del propio grupo cultural) en encuentros intergrupales en comparación con situaciones en las que la identidad grupal no es saliente.. Nuestros resultados apoyan parcialmente esta predicción. Los Gitanos, que tienen un fuerte sentido de identidad étnica, castigaron (pero sólo los hombres) a los Gitanos que no cooperaban cuando interactuaban con no-Gitanos en grupos mixtos, pero no en grupos homogéneos formados sólo por Gitanos. Esta observación es consistente con la hipótesis de que el castigo juega un papel importante en la evolución de la cooperación a través de su impacto en los procesos intergrupales como sostienen los teóricos de la selección (cultural) grupal. Interpretamos este resultado como un reflejo de que los hombres Gitanos usan el castigo en el experimento eminentemente en respuesta a una clara amenaza de identidad grupal: el de ser vistos como menos cooperativos que los no-Gitanos. Por lo tanto, se puede inferir que la norma clave para los Gitanos (la que debe reforzarse mediante sanciones), no es la cooperación en sí misma, sino la preservación de una identidad étnica de la que están orgullosos.
4. El comportamiento de castigo de los no-Gitanos en grupos mixtos parece inconsistente con las predicciones básicas de las teorías de selección de grupos culturales, pero también con las de la hipótesis del Gran Error. Puede ser que la identidad grupal menos marcada o el estatus de grupo mayoritario de los no-Gitanos contribuya a explicar la discrepancia con el comportamiento de castigo de los Gitanos, que sí se alinea bien con las predicciones de la selección de grupos culturales tanto en grupos homogéneos como mixtos.
5. Encontramos algunos indicios de que los Gitanos castigaron de forma "maliciosa" más a los no-Gitanos que a los Gitanos cooperativos (es decir, castigo antisocial). Este resultado está en línea con la predicción de las teorías de selección de grupos culturales también, pero el nivel de castigo antisocial en los grupos mixtos fue demasiado bajo para llegar a una conclusión firme.
6. Mientras que las mujeres contribuyeron al bien público más en grupos mixtos que en grupos homogéneos, se observa lo contrario para los hombres. Además,

en contraste con lo que observamos para las mujeres, los hombres castigaron en general más en grupos mixtos que en grupos homogéneos. Estos dos resultados son similares para los participantes Gitanos y no-Gitanos, lo que sugiere la existencia de diferencias de género comunes a ambos grupos culturales. Una de las causas de tales diferencias de género puede ser la aversión al riesgo.

7. Sin embargo, mientras que el castigo de las mujeres no-Gitanas era fuertemente modulado por el tipo de grupo (alto en grupos homogéneos y bajo en grupos mixtos), las mujeres Gitanas casi no castigaron en ninguna condición. Este resultado puede reflejar unos roles de género diferenciales y específicos de cada cultura en cuanto al refuerzo de normas. De hecho, el hallazgo es consistente con la evidencia etnográfica que sugiere que las normas culturales Gitanas prescriben que las mujeres deben reducir su asertividad en presencia de los hombres (Gitanos), que son quienes deben liderar más ostensiblemente las interacciones sociales en tales situaciones. Estos marcados roles de género son mucho menos frecuentes entre los no-Gitanos.

En resumen, mientras que nuestros resultados son más consistentes con las teorías de selección de grupos culturales y la psicología normativa asociada a ellas que con las teorías basadas en el gran error y la selección individual, varios hallazgos cuestionan una visión estricta de cómo los procesos de selección de grupos culturales deberían traducirse en comportamientos observados. A raíz de estos resultados, en efecto, surgen nuevas e preguntas cuyas respuestas podrían enriquecer las teorías de la selección grupal y que merecen ser exploradas en futuras investigaciones. En particular, los diferentes roles de los grupos con estatus de mayoría y minoría en los encuentros intergrupales, que no han sido estudiados en profundidad, podrían desembocar en diferencias de comportamiento que se alejan de las predicciones teóricas básicas.

Preferencias temporales

En cuanto a las decisiones intertemporales de los individuos involucrados en procesos de discriminación intergrupal y fragmentación étnica, nuestros datos respaldan

los argumentos adaptacionistas de los modelos más importantes basados en las Teorías de Historia de Vida. Añadimos además una perspectiva evolucionista al desarrollo del descuento temporal y su posible relación con los procesos de discriminación intergrupal. En los capítulos 3 y 4, en la sección *Dicussion, se* discute extensamente los resultados y aporta una serie de conclusiones detalladas. A continuación, simplemente se enumeran las principales conclusiones en este sentido y se remite al lector a los mencionados capítulos para una mayor profundidad de análisis:

1. La perspectiva evolutiva de la Teoría de Historia de Vida puede ser muy útil para comprender las raíces de las diferencias individuales en descuento temporal. De acuerdo con esta perspectiva, descontar el futuro en gran medida no se considera necesariamente un comportamiento maladaptativo, sino que podría ser una respuesta contextualmente adecuada a las señales ambientales de dureza que fomentan estrategias de historia de vida rápidas (frente a lentas).
2. Los participantes del grupo étnico que enfrentan condiciones ecológicas más duras e impredecibles descuentan más el futuro incluso después de controlar el estatus socio-económico actual de los individuos. Los argumentos adaptacionistas de Historia de Vida aplicados a nuestros resultados implicarían que los Gitanos descuentan el futuro en gran medida debido a factores ambientales incontrolables que hacen que una preferencia por el presente sea contextualmente apropiada, al menos en el momento del desarrollo en el que se establece este rasgo. Además, el estatus socio-económico actual pierde casi todo su poder explicativo sobre el descuento temporal una vez que se tiene en cuenta la etnicidad. Esto puede implicar en última instancia que alguna fracción de la relación reportada previamente en la literatura entre las variables socio-económicas y la impaciencia podría ser debida a factores no observados relacionados con las condiciones ecológicas bajo las cuales se desarrollaron los individuos, en lugar de únicamente al estatus socio-económico actual de los individuos.
3. Nuestros resultados sugieren que descontar el futuro en gran medida podría ser una respuesta contextualmente apropiada a las (duras) condiciones ambientales a las que se enfrentan los Gitanos. Nuestros datos indican que la formación de

las preferencias temporales de los individuos puede verse influida por factores sociales a nivel grupal, como la discriminación y la segregación, a través de su impacto directo en la dureza ambiental. Esta hipótesis se examina en mayor profundidad en el último estudio (ver conclusiones 6-8 debajo).

4. El estudio de sólo dos grupos étnicos que difieren en varios factores socio-ecológicos actuales e históricos (tales como la esperanza de vida, el estado socioeconómico y de salud, las tasas de discriminación y persecución) imposibilita una disección sistemática de los efectos parciales de cada una de estas diferencias a nivel de grupo sobre el descuento temporal. Con los datos usados, la causalidad es difícil de evaluar y muchas preguntas quedan sin respuesta.
5. Investigaciones futuras deberían tratar de dilucidar qué parte de las diferencias interétnicas en cuanto a impaciencia podrían entenderse como un reflejo de adaptaciones a nivel grupal (transmitidas culturalmente) en lugar de adaptaciones a nivel individual a las condiciones del grupo. Los rasgos de historia de vida, de hecho, pueden adquirirse a través de la transmisión cultural. En nuestro caso, la experiencia histórica común de discriminación y persecución de la población Gitana, que hoy en día es mucho más reducida en comparación con siglos pasados, es una clara candidata para representar una influencia cultural sobre el comportamiento de descuento los Gitanos. Sin embargo, sólo el estudio de un número mayor de grupos étnicos con diversas diferencias a nivel grupal (en términos de condiciones socio-ecológicas actuales e históricas) puede abordar esta cuestión de manera efectiva. Sin embargo, tal ejercicio inevitablemente conduciría a una pérdida de control experimental, ya que la inclusión de un mayor número de grupos étnicos, en la medida en que no viven todos en el mismo lugar, implicaría que entren en juego muchos factores, como la geografía, la disponibilidad de recursos naturales, el clima y el régimen político, que pueden confundir las relaciones observadas.
6. Basados en modelos de ecuaciones estructurales, nuestros resultados muestran una fuerte relación positiva entre una proxy que mide la incidencia de procesos de discriminación intergrupal a nivel de país (es decir, el *Group Grievance index, Fund For Peace*) y el descuento temporal promedio de sus habitantes, que está parcialmente mediado por las condiciones socio-ecológicas del país.

Este hallazgo es robusto para diferentes especificaciones estadísticas, y para dos conjuntos de datos y medidas diferentes de descuento. Es decir, los procesos de discriminación intergrupal pueden desencadenar condiciones ambientales adversas (o percibidas como tales) que, a su vez, hacen que las personas respondan de manera adaptativa orientándose más hacia el corto plazo.

7. En cuanto al efecto de la fragmentación étnica como precursora de la discriminación intergrupal, los resultados no son tan concluyentes y varían en función de la base de datos de descuento temporal que se use. Los indicadores de segregación espacial y, en menor medida, de fraccionalización parecen ajustarse un poco mejor a las predicciones que los de desigualdad y, sobre todo, de polarización étnica. Sin embargo, resulta más complicado obtener conclusiones firmes de este análisis pues, aunque los resultados siempre van en la dirección esperada, a veces los efectos totales estimados de las variables de fragmentación étnica sobre la paciencia no son estadísticamente significativos y hay diferencias importantes según se use una u otra medida de descuento.
8. Existe un vínculo entre las condiciones socio-ecológicas severas y la impaciencia (es decir, un alto descuento) no sólo cuando las primeras están basadas en la esperanza de vida o el PIB per cápita, como en investigaciones anteriores, sino también cuando la dureza ambiental se aproxima por la tasa de mortalidad infantil, que no se había explorado hasta ahora. Además, demostramos que la existencia de procesos de discriminación entre grupos es una fuente potencial de dureza ambiental, de acuerdo con las tres medidas utilizadas.

Estos resultados contribuyen a reforzar la evidencia sobre el impacto de las condiciones socio-ecológicas en las decisiones intertemporales de los individuos, apoyando así los modelos basados en la Teoría de Historia de Vida. Por otro lado, ofrecemos evidencia en favor de una explicación al ya famoso vínculo (negativo) entre fragmentación étnica y prosperidad económica. En última instancia, si la discriminación intergrupal imposibilita la provisión de los bienes públicos necesarios para lubricar el desarrollo económico y los entornos adversos, a su vez, incrementan la impaciencia de los individuos, es muy probable que se generen círculos viciosos, en el sentido de que una

población más impaciente (por adaptación al contexto) tenga más tendencia a la discriminación y mayores problemas a la hora de proveer bienes públicos.

APPENDIX

Appendix

Appendix Chapter 2

Figure A1. *Contribution decision card. (Example; translated from Spanish). (Yellow #1 participant example)*

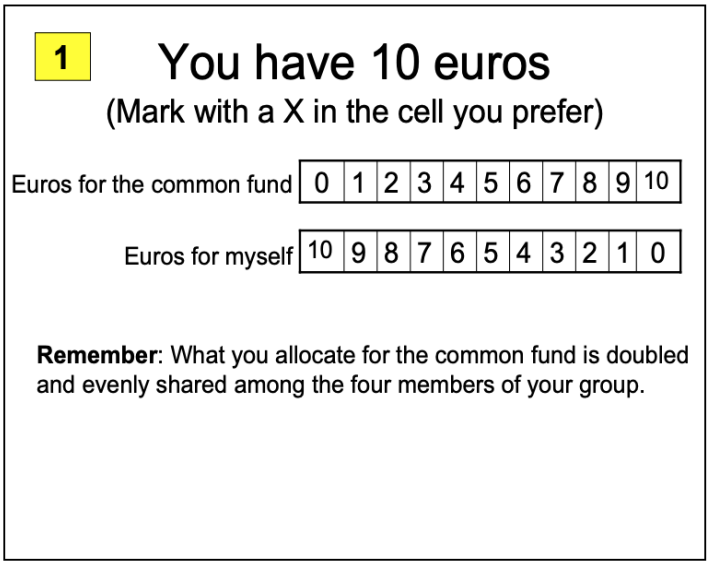
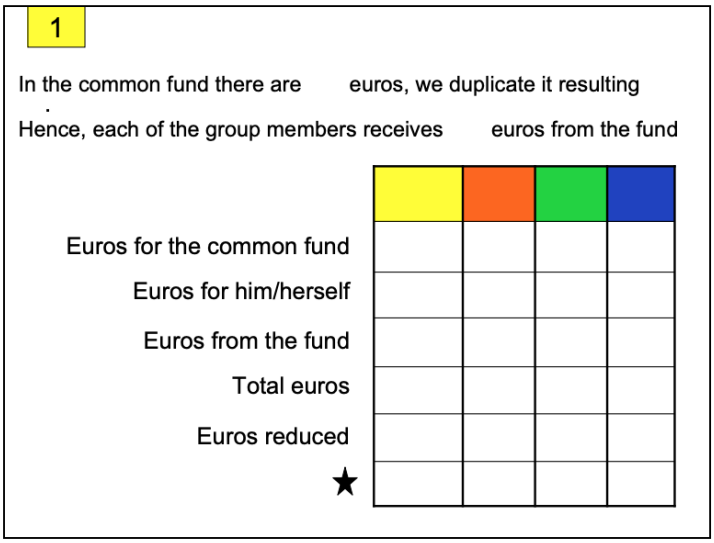


Figure A2. *Punishment decision card. (Example; translated from Spanish).). (Yellow #1 participant example)*



Appendix Chapter 3

S1. The delay discounting task

For the experiment, we used an adaptation of the intertemporal choice task used by Harrison et al. (2002; see main text). We decided to use a front-end delay procedure to capture long-term discounting behavior and minimize the effect of distrust (in terms of whether the experimenters will effectively come back to the town to pay participants) on individuals' choices. To do this, we employed a task consisting of 20 categories ranging from 2% to 100% simple annual interest rate (r). The procedure was as follows.

Four assistants delivered the delay discounting decision sheet to the participants (each session consisted of 32 individuals, always with the same instructor [PBG] conducting the experiments). As can be seen in Figure S1, the decision sheet contained a table with two main columns (options A and B) and 20 rows. In each row, option A offered €150 to be received one month after the experiment, while option B offered a higher amount to be received seven months after the experiment. In an extra column, the participants could see the interest rate associated with the six-month wait (that is, with choosing option B), which increases across rows from 2% to 100%. Thus, option B in the first row offered €151.50 (i.e. $r = 0.02$) and option B in the twentieth row offered €225 ($r = 1$). The participants had to choose between option A and B in each of the 20 rows by marking with a cross on the corresponding column.

In order to avoid mistakes and, more specifically, inconsistent choices – a frequent problem with multiple-price-list tasks, where multiple switching patterns are often observed, even among university students –, the instructor conducted the task row by row. Subjects were asked, scenario by scenario, to choose between A and B. Moreover, they were advised that once option B was reached they should stay at that point, given that once B has been already chosen it makes no sense to switch to option A again in the next row. Given the (expected) low educational level of a non-negligible proportion of our participants (see Table 1 in the main text), we believe that this systematic procedure importantly reduced the number of mistakes. Since inconsistent choices impede the estimation of an individual's discount rate, we thus reduced a potentially high number of missing observations to zero.

The participants were told that because of financial constraints only one, randomly selected individual per session would be paid for this part of the experiment. Once the decision sheets were collected, the "winner" and the "prize" (row) were randomly selected by picking numbered balls from an opaque bag in front of the participants. The average earnings of the five selected participants were €166.50. One member of the team [AME] phoned each of them in order to arrange a meeting for payment after one or seven months depending on the option chosen by the participant in the randomly selected row. This was common knowledge among participants when making their decisions. Since both options in the task were delayed (front-end delay), our design avoids the problem of different transaction costs between options – including different levels of trust in getting actually paid.

Figure S1. *Screenshot of the delay discounting decision sheet (translated from Spanish)*

Mark with an X the chosen option

	1 MONTH OPTION A	**7 MONTHS** OPTION B	INTEREST	A	B
1	150.00 €	151.50 €	2%		
2	150.00 €	154.00 €	5%		
3	150.00 €	157.50 €	10%		
4	150.00 €	161.00 €	15%		
5	150.00 €	165.00 €	20%		
6	150.00 €	169.00 €	25%		
7	150.00 €	172.50 €	30%		
8	150.00 €	176.00 €	35%		
9	150.00 €	180.00 €	40%		
10	150.00 €	184.00 €	45%		
11	150.00 €	187.50 €	50%		
12	150.00 €	191.00 €	55%		
13	150.00 €	195.00 €	60%		
14	150.00 €	199.00 €	65%		
15	150.00 €	202.50 €	70%		
16	150.00 €	206.00 €	75%		
17	150.00 €	210.00 €	80%		
18	150.00 €	214.00 €	85%		
19	150.00 €	217.50 €	90%		
20	150.00 €	225.00 €	100%		

S2. Robustness checks for secondary analyses

In this section, we complement the statistical analysis reported in the main text based on Spearman correlations (Table 2). In particular, we check the robustness of those

analyses which include at least one binary variable to more appropriate statistical tests (i.e. either Mann-Whitney test or Fisher's exact test in the case of two binary variables; two-tailed).

According to Mann-Whitney test,

- compared to a non-*Gitano*, the probability that a *Gitano*: chooses the sooner-smaller reward more often in the DD task is 68.2% ($p<0.001$); is older is 27.6% ($p<0.001$); reports a higher personal income is 37.9% ($p=0.008$); reports a higher (other) household's income is 32.6% ($p<0.001$); reports a higher number of years of schooling is 27.1% ($p<0.001$).
- compared to a female, the probability that a male: chooses the sooner-smaller reward more often in the DD task is 50.2% ($p=0.962$); is older is 46.3% ($p=0.451$); reports a higher personal income is 65.9% ($p<0.001$); reports a higher (other) household's income is 40.0% ($p=0.034$); reports a higher number of years of schooling is 53.0% ($p=0.509$).
- compared to someone without regular income, the probability that a participant with regular income: chooses the sooner-smaller reward more often in the DD task is 43.5% ($p=0.171$); is older is 69.7% ($p<0.001$); reports a higher personal income is 87.9% ($p<0.001$); reports a higher (other) household's income is 42.5% ($p=0.110$); reports a higher number of years of schooling is 52.1% ($p=0.636$).

According to Fisher's exact test,

- compared to non-*Gitanos*, *Gitanos* are 18.2% more likely to be male (46.9% vs. 28.7%; $p=0.027$) and 23.3% less likely to report a regular income (25.0% vs. 48.3%; $p=0.004$).
- compared to females, males are 21.0% more likely to be *Gitano* (54.5% vs. 35.4%; $p=0.027$) and 22.5% more likely to report a regular income (52.7% vs. 30.2%; $p=0.009$).
- compared to those without regular income, participants with regular income are 24.0% less likely to be *Gitano* (27.6% vs. 51.6%; $p=0.004$) and 22.0% more likely to be male (50.0% vs. 28.0%; $p=0.009$)

S3. Robustness checks for the treatment of missing values

Table S1 replicates the set of regressions presented in Table 3 in the main text but replacing the nine missing values with the sample average of the variable in each case.

Table S1. *Interval regression estimation of individuals' DD (K) without exclusions*

	1a	1b	2a	2b	3a	3b	4a	4b
dep. var.:	*Hyper-K*	*Exp-K*	*Hyper-K*	*Exp-K*	*Hyper-K*	*Exp-K*	*Hyper-K*	*Exp-K*
Ethnicity (*Gitano*)	0.395***	0.279***	0.455***	0.320***	0.432***	0.303***	0.359**	0.250**
	(0.098)	(0.070)	(0.106)	(0.076)	(0.124)	(0.088)	(0.174)	(0.124)
Gender (male)			-0.092	-0.068	-0.039	-0.030	-0.036	-0.028
			(0.103)	(0.074)	(0.107)	(0.076)	(0.121)	(0.086)
Age			-0.027*	-0.020*	-0.022	-0.016	-0.023	-0.016
			(0.016)	(0.016)	(0.016)	(0.011)	(0.016)	(0.011)
Age^2			0.029*	0.021*	0.025	0.018	0.024	0.018
			(0.018)	(0.013)	(0.017)	(0.012)	(0.017)	(0.012)
Regular Income					0.080	0.058	0.072	0.053
					(0.141)	(0.101)	(0.141)	(0.101)
own income (€0, €500)					-0.141	-0.103	-0.165	-0.119
					(0.143)	(0.102)	(0.148)	(0.105)
own income [€500, €1000)					-0.213	-0.155	-0.222	-0.162
					(0.161)	(0.115)	(0.160)	(0.115)
own income [€1000, €2000)					-0.121	-0.080	-0.175	-0.120
					(0.205)	(0.145)	(0.219)	(0.155)
own income [€2000, €3000)					-0.711**	-0.523**	-0.651**	-0.477**
					(0.288)	(0.214)	(0.317)	(0.235)
other household's income (€0, €500)							0.058	0.036
							(0.138)	(0.098)
other household's income [€500, €1000)							-0.064	-0.049
							(0.144)	(0.103)
other household's income [€1000, €2000)							-0.172	-0.122
							(0.154)	(0.110)
other household's income [€2000, €3000)							-0.237	-0.174
							(0.225)	(0.160)
other household's income ≥€3000							-0.197	-0.144
							(0.220)	(0.155)
Years schooling							0.007	0.005
							(0.018)	(0.013)
Constant	0.651***	0.512***	1.165***	0.895***	1.134***	0.871***	1.233***	0.946***
	(0.058)	(0.041)	(0.330)	(0.238)	(0.318)	(0.225)	(0.427)	(0.301)
ln sigma Cons.	-0.581***	-0.917***	-0.592***	-0.928***	-0.607***	-0.944***	-0.616***	-0.954***
	(0.075)	(0.077)	(0.073)	(0.075)	(0.073)	(0.075)	(0.074)	(0.075)
chi^2	16.28***	15.85***	20.34***	19.89***	30.13***	28.84***	37.85***	37.77***
ll	-413.482	-410.038	-411.638	-408.136	-409.395	-405.740	-408.366	-404.743
Pseudo-R^2	0.097	0.095	0.118	0.116	0.142	0.142	0.153	0.153
N	160	160	160	160	160	160	160	160

*Notes: Interval regression estimates. Model 1 tests the effect of ethnicity on DD without control variables. In model 2, demographic controls are included (Age2 refers to Age2/100). Whether the individual has a regular income source and the individual's own monthly income (omitted category: €0) are also controlled for in model 3. Finally, model 4 also controls for other household's income (omitted category: €0) and years of schooling. For each model specification, Hyper-K and Exp-K are the dependent variable in column (a) and (b), respectively. Robust standard errors in parentheses. Pseudo-R2 refers to Cox-Snell's index. * p<0.1, ** p<0.05, *** p<0.01, two-tailed.*

Appendix Chapter 4

Please scan the QR code to access the interactive data and figures, or alternatively go to http://bit.ly/worlddistribution

(a) Description of the ethnic fragmentation measures

a.1. "Ethnic Frac AAL"

This variable has been extracted from Alesina et al. (2003), who started from the data published within the Atlas Narodov Mira (1964) where the ethnic and linguistic differences were jointly combined into a measure of ethnolinguistic fractionalization. The variable is computed as one minus the Herfindahl index of the ethnolinguistic groups, and reflects the probability that two individuals randomly selected from a population belong to different groups. Formally, fractionalization is given by:

$$\text{FRACT}_j = 1 - \sum_{i=1}^{N} s_{ij}^2,$$

Where S_{ij} is the share of country j represented by group i.

In regions such as Africa, racial or physical criteria are rarely used to define ethnic groups (and language is used instead), whereas in others such as Latin America these are used very often. Therefore, it is difficult distinguishing between ethnic and linguistic variables in many parts of the world because language is a key factor within the criteria used by ethnologists and anthropologists to define the concept of ethnicity.

For this reason, to compute an accurate index of ethnic fractionalization, Alesina et al. (2003) gathered data about a number ethnic groups which were as disaggregated as possible (the largest number of ethnic groups ever reported, covering approximately 650

different groups in the 190 countries used in their paper). Several data sources were required, which the authors systematically compared one to each other in order to ensure consistency. The main source was the *Encyclopedia Britannica (2000)* (which employs the concept of geographical race), which was used in 124 out of the 190 countries, and was completed with data from CIA (2000), Levinson (1998) y Minority Rights Group International (1997).

As can be seen in Figure 6a, the countries in our sample with the largest ethnic fraccionalization according to the Alesina et al.'s (2003) measure are, in order, Uganda, Cameroon, Kenya, Nigeria, Angola, Afghanistan, South Africa, Bolivia, Tanzania and Indonesia. Likewise, the countries displaying lowest levels of fractionalization, in order, are Japan, South Korea, Bangladesh, Portugal, Norway, Sweden, Hong Kong, Denmark, Australia and Haiti.

a.2 "Ethnic Frac MRQ"

This measure of ethnic fractionalization was borrowed from Montalvo & Reynal-Querol (2005a). Their data was obtained from the World Christian Encyclopedia (WCE), which contains detailed classifications for each country coinciding with ethnolinguistic families or subfamilies.

The WCE presents an ethnolinguistic classification based on the various existing schemes about language proximity, racial, ethnic and cultural characteristics. It combines race, language and culture into an ethnolinguistic classification which includes several more detailed levels.

As above, the fractionalization index reflects the probability that two individuals randomly selected from a population belong to different groups.

Figure 6b shows that the countries in our sample with higher fractionalization according to the Montalvo & Reynal-Querol's (2005a) index are, in order, Tanzania, Uganda, India, Kenya, Nigeria, Philippines, Cameroon, Angola, Indonesia and Canada. On the other side, with the lowest fractionalization values, we find Portugal, South Korea, Japan, Hong Kong, Norway, Denmark, Poland, Saudi Arabia, Bangladesh and Ireland.

a.3. "Ethnic Segregation"

This is a measure of ethnic (geographical) segregation obtained from Alesina & Zhuravskaya (2011). To gather these data, they used regions or subnational administrative units as geographical observation units. For each of these regions, they then compiled data about the total population size and the fraction of the population belonging to the different ethnic groups. The data was collected from the census for 2000 or the closest year available.

Upon this information, they built a segregation index which takes the value of 1 if each group occupies one separate region and, hence, each region is fully homogeneous, even if the country as a whole is fractionalized. The index takes the value of 0 if each region has the same ethnic composition as the entire country. Formally, the index is defined as follows (see also Reardon & Firebaugh 2002):

$$S^i = \frac{1}{M^i - 1} \sum_{m=1}^{M^i} \sum_{j=1}^{J^i} \frac{t_j^i}{T^i} \frac{(\pi_{jm}^i - \pi_m^i)^2}{\pi_m^i}$$

Where T^i is the population size of country i, and t^i_j is the population size of region j from country i. J^i is the total number of regions in country i.

As can be seen in Figure 6e, the countries in our sample with higher levels of ethnic segregation according to this index are, in order, Zimbabwe, Guatemala, Afghanistan, Uganda, Turkey, Pakistan, Colombia, Morocco, South Africa and Spain. Likewise, the countries with lowest segregation levels are, in order, Germany, Sweden, Netherlands, South Korea, Japan, Greece, Slovenia, Hungary and Ireland.

.

a.4."Ethnic Polar"

This measure of ethnic polarization was obtained from Montalvo & Reynal-Querol (2005b), who used the WCE to build their dataset.

It is taken for granted that the degree of polarization increases along with the "distance" between the characteristics of the groups. However, when groups are based on ethnicity the concept of "distance" is hard to define and be captured with simple measures, so that it is assumed that the distance between every two groups is identical. For indexes accounting for other variables such as wealth or income, however, distances can be calculated (see the measures of ethnic inequality below).

Given that distances are taken as constant, the measures of polarization only depend on the sizes of the groups. Montalvo & Reynal-Querol (2005b) used an index measuring the normalized difference between the observed distribution of ethnic groups with respect to a bimodal distribution. Formally, it is defined as (see also Reynal-Querol 1998):

$$Q = 1 - \sum_{i=1}^{N} \left(\frac{1/2 - \pi_i}{1/2} \right)^2 \pi_i = 4 \sum_{i=1}^{N} \pi_i^2 (1 - \pi_i).$$

Where π_i is the share of people belonging to the ethnic group i, and N is the number of groups.

As Figure 6f shows, the countries in our sample with more polarization are, in order, Jordan, Guatemala, Morocco, Belgium, Peru, Colombia, Afghanistan, Brazil, Bolivia and Malawi. On the other hand, the countries with lowest polarization levels are Portugal, Hong Kong, Japan, Norway, Denmark, Poland, Saudi Arabia, Bangladesh, Ireland and Italy.

a.5. "Ethnic Ineq ASN"

This measure of ethnic inequality was extracted from Alesina et al. (2016). To overcome the scarcity of data on income along ethnic lines and being able to build country-level ethnic inequality indicators for the largest number of countries, they combined ethnographic and linguistic maps with data about light density. Recent studies demonstrate that luminosity is a good proxy for economic development at different aggregation levels (countries, regions, locations and so on; see for instance Henderson et al. 2012).

Alesina and colleages first identified the location of each group using the georeferentiation of ethnic groups (GREG), which the digitalized version of the *Atlas Narodov Mira* (Weidmann et al. 2010) where the regions populated by 928 different ethnic groups across the world are represented. It must be noted that the data of the *Atlas Narodov Mira* are mainly based on linguistic distinctions and may hide other aspects of ethnicity such as the racial background or the skin color.

They later on used satellite images of light density during night as a proxy for economic prosperity of the region. To calculate luminosity at the desired level, all the observations contained within the boundaries of the ethnic groups were averaged and then divided by the population size of each area for 2000 estimated using Gridded Population of the World 2000 (which reports estimates for population size at the level of georeferenced pixels for 1990 and 2000).

Finally, the level of economic development at the ethnic homeland with average luminosity per capita were used to compute an ethnic Gini coefficient for each country reflecting the inequality between ethnolinguistic regions. More specifically, the Gini coefficient for a country consisting of n ethnic groups with luminosity per capita y_i at the homeland of ethnic group i is computed as follows:

$$G = \frac{1}{n}\left(n + 1 - 2\frac{\sum_{i=1}^{n}(n+1-i)\,y_i}{\sum_{i=1}^{n} y_i}\right)$$

Where $i = 1,\ldots n$ is indexed in non-creasing order ($y_i \leq y_{i+1}$)

As can be seen in Figure 6c, the countries in our sample with higher ethnic inequality according to this measure are, in order, Afghanistan, Russia, Bolivia, Peru, Brazil, Algeria, Nigeria, Finland, China and Georgia. Likewise, the countries with lower ethnic inequality are South Korea, New Zealand, United Arab Emirates, Lebanon, Lithuania, Hungary, Moldova, Turkey, Poland and Ireland

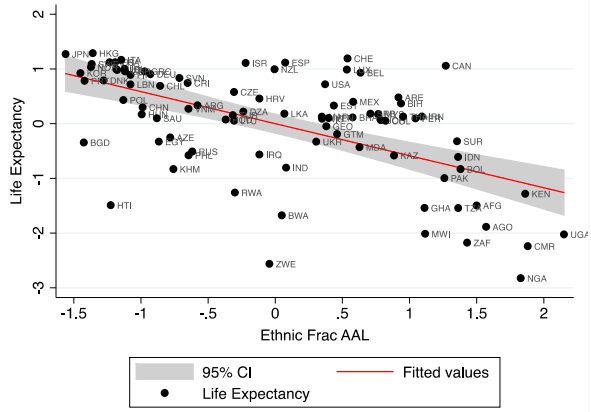
a.6. “Ethnic Ineq Ethnol”

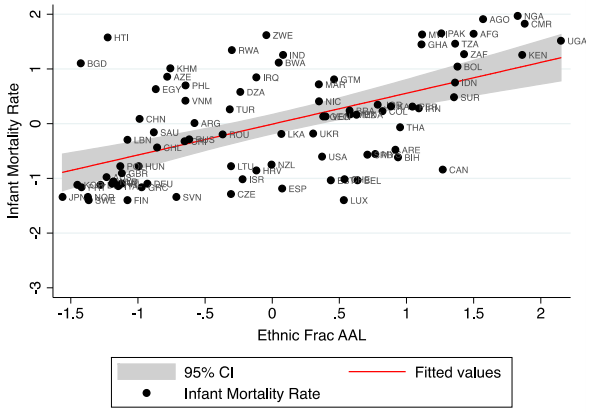
This measure of ethnic inequality is also borrowed from Alesina et al. (2016). The only difference with respect to the Ethnic Ineq ASN measure above is that in this case, to locate the ethnic groups they used the 15th edition of *Ethnologue* (Gordon 2005). Then, to build the indicator, traditional linguistic regions were delineated mapping in this way a total of 7581 groups in all across the world.

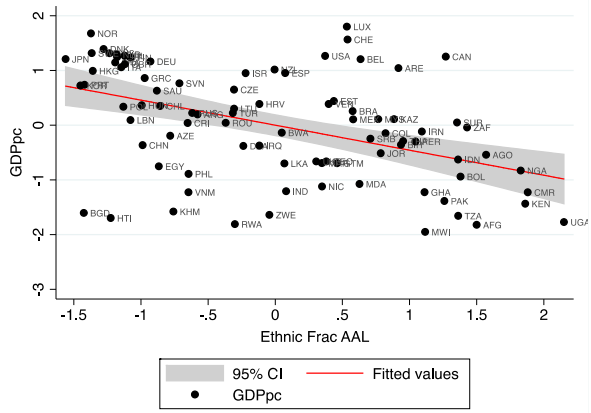
Cas can be seen in Figure 6d, the countries in our sample with higher ethnic inequality levels according to this measure are, in order, Peru, Cameroon, Indonesia, Nigeria, Zimbabwe, Afghanistan, Angola, Colombia, Russia and Brazil. On the opposite side, the countries with lowest ethnic inequality levels are South Korea, Croatia, Haiti, Estonia, Rwanda, New Zealand, Luxembourg, United Arab Emirates, Slovenia and Lebanon.

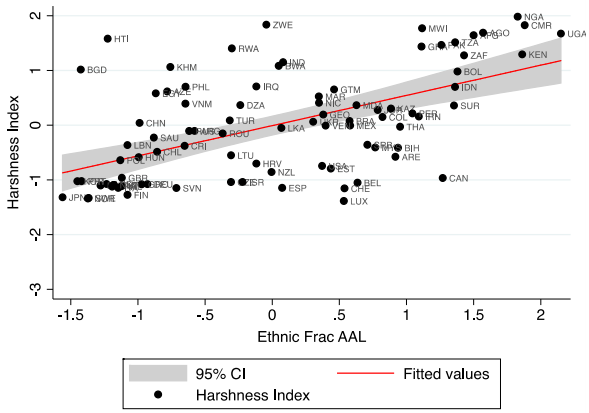
(b).- Linear relationship between measures of ethnic fragmentation and measures of socioecological conditions.

b.1.- Ethnic Frac AAL

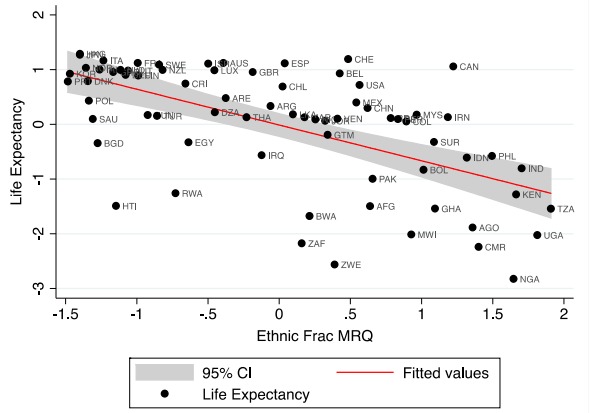


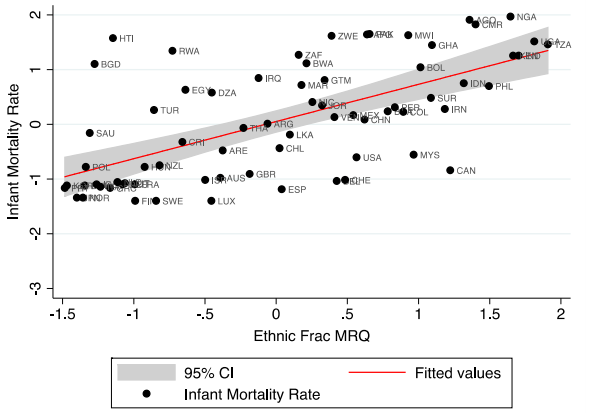


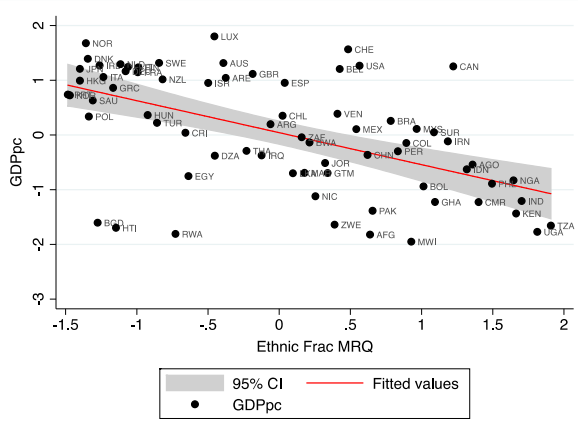


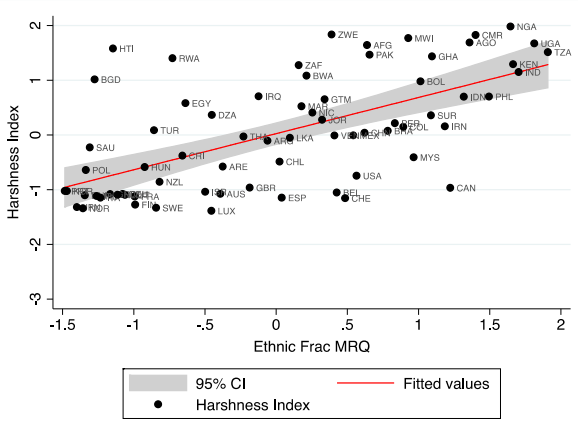


b.2.- Ethnic Frac MRQ

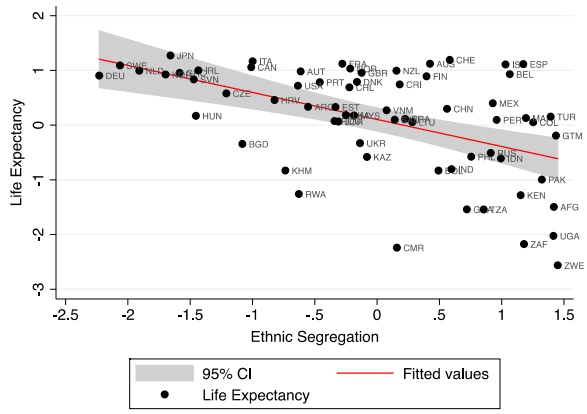


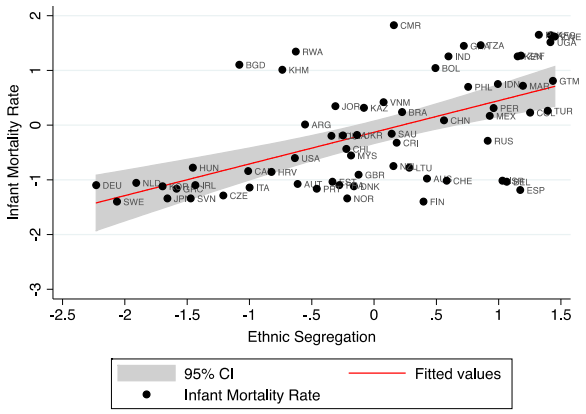


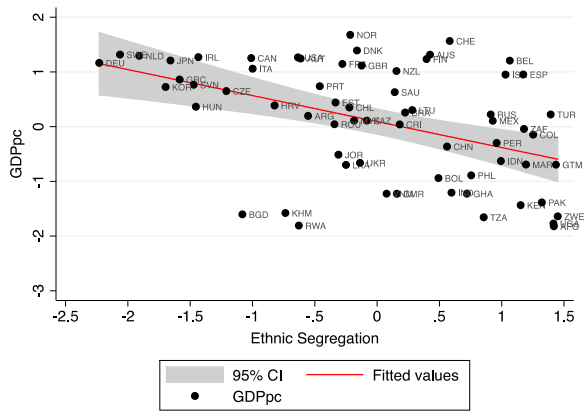


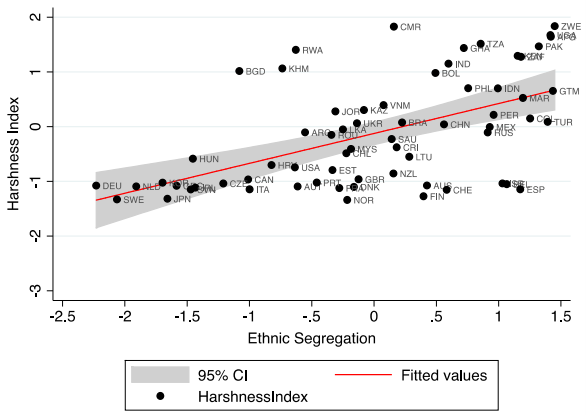


b.3.- Ethnic Segregation

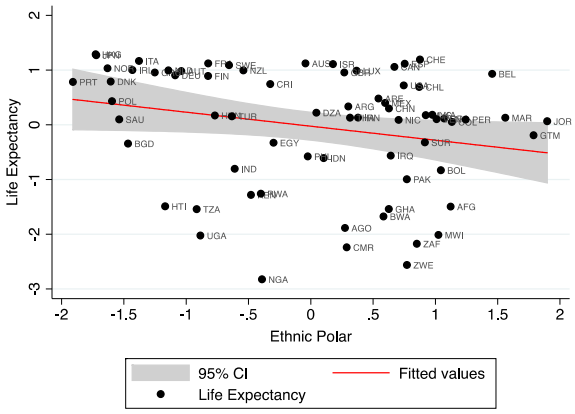


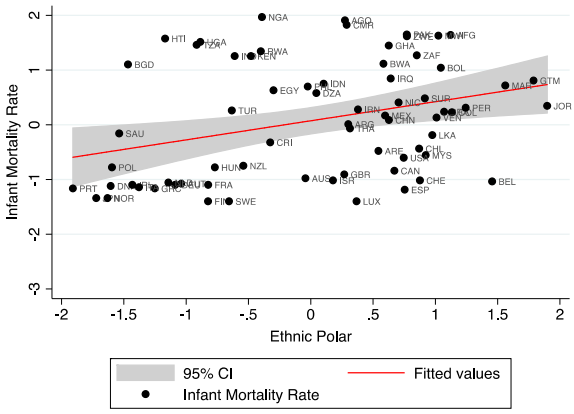


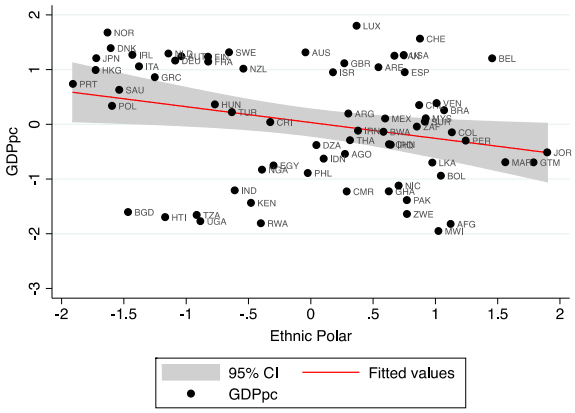


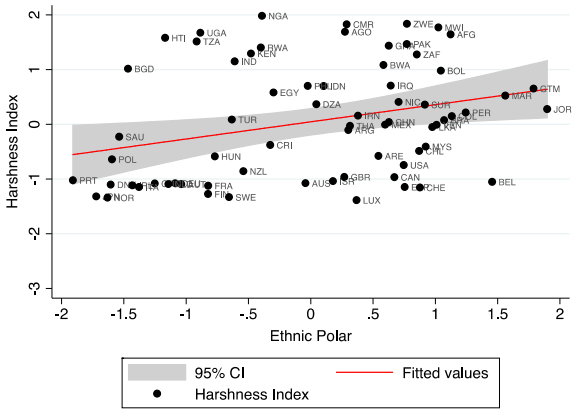


b.4.- Ethnic Polar

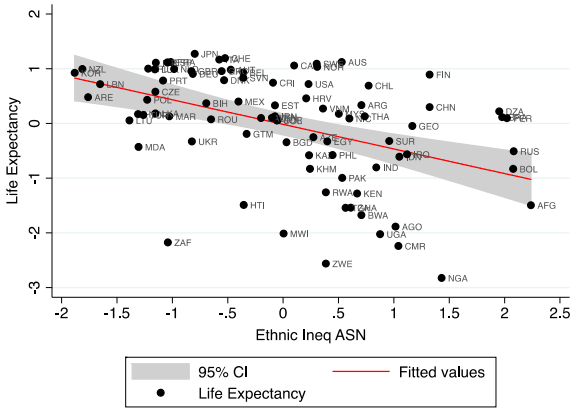


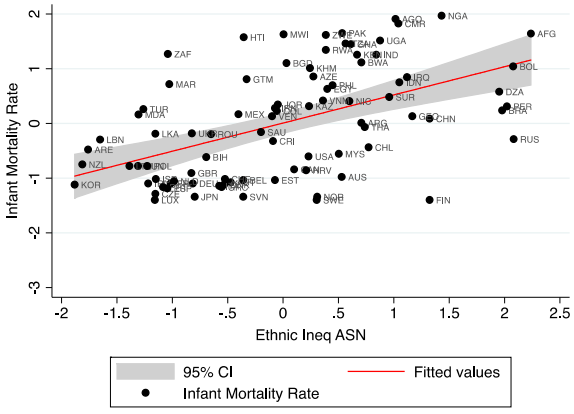


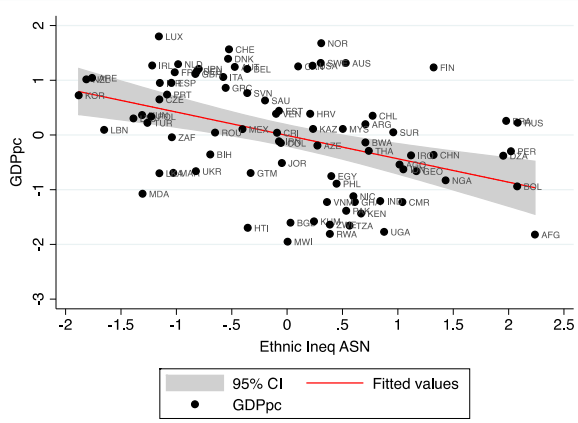


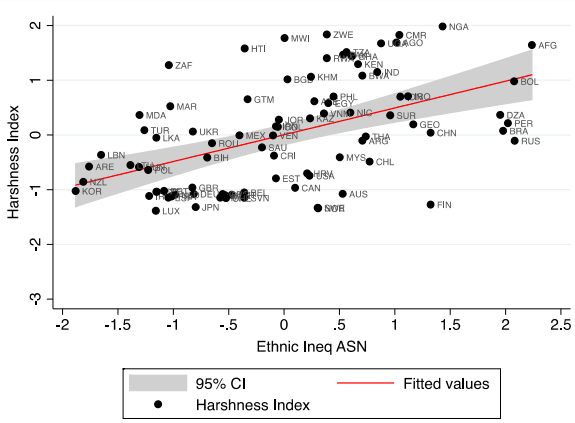


b.5.- Ethnic Ineq ASN

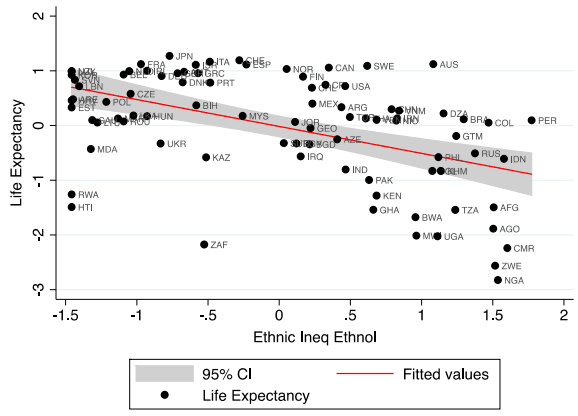


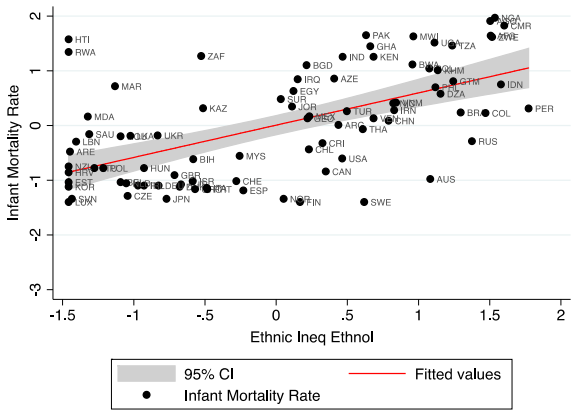


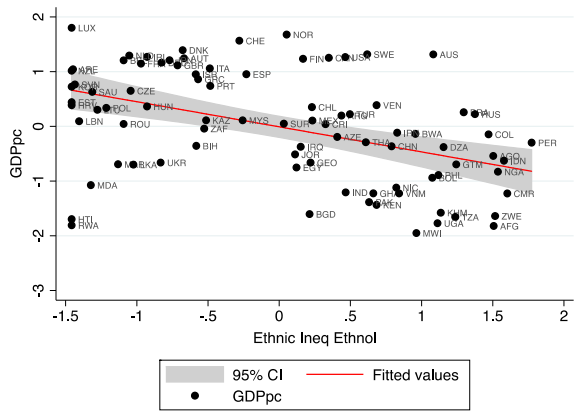


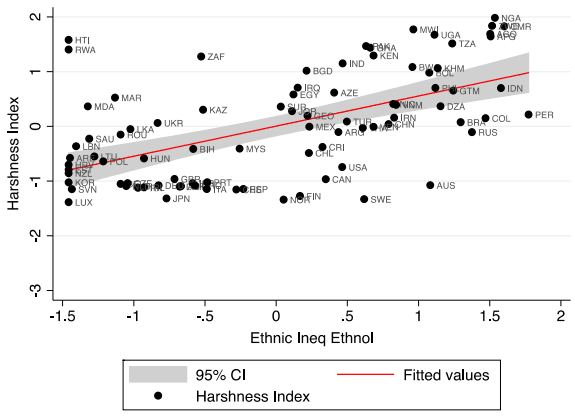


b.6.- Ethnic Ineq Ethnol



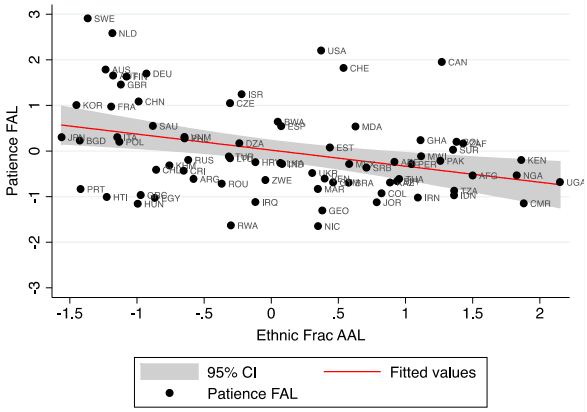


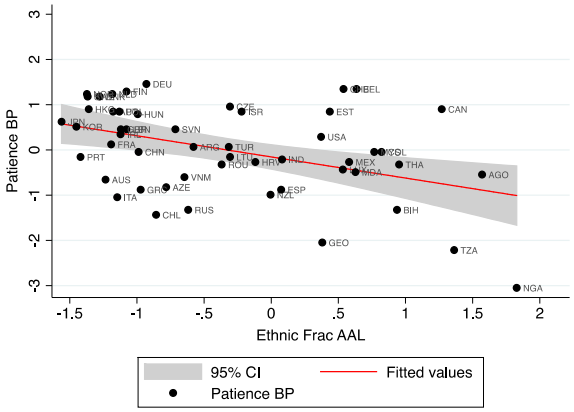




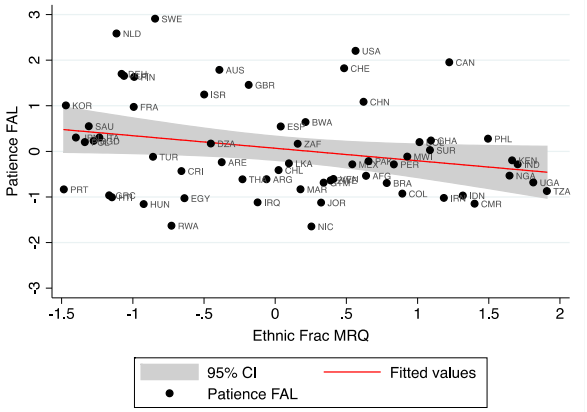
(c).-Linear relationship between measures of intertemporal choices and measures of socioecological conditions.

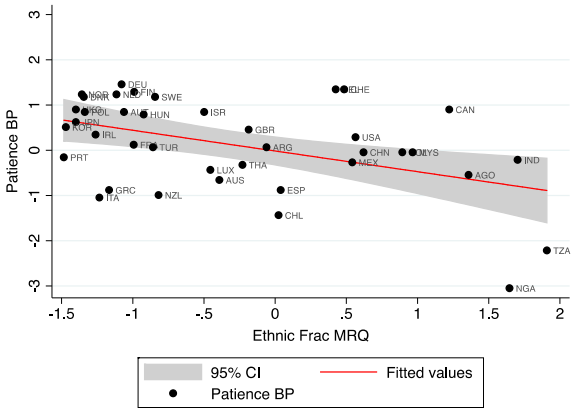
c.1.- Ethnic Frac AAL



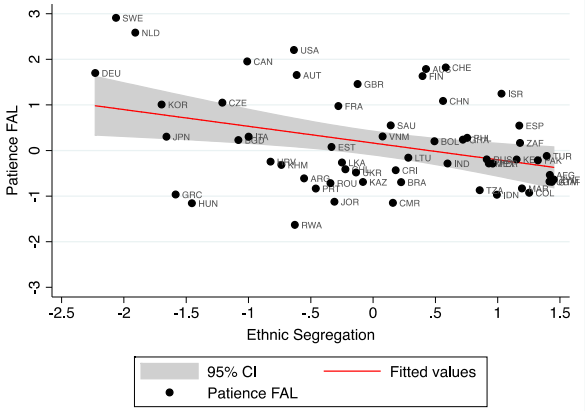


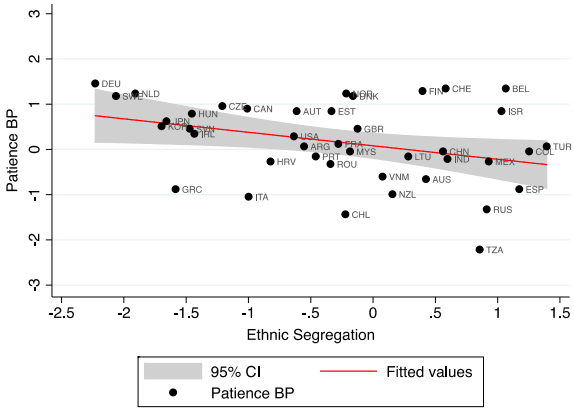
c.2.- Ethnic Frac MRQ



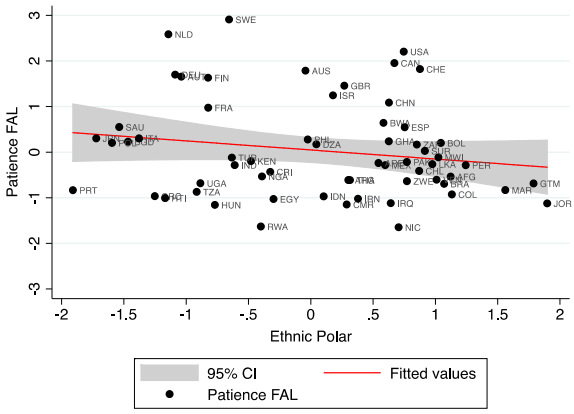


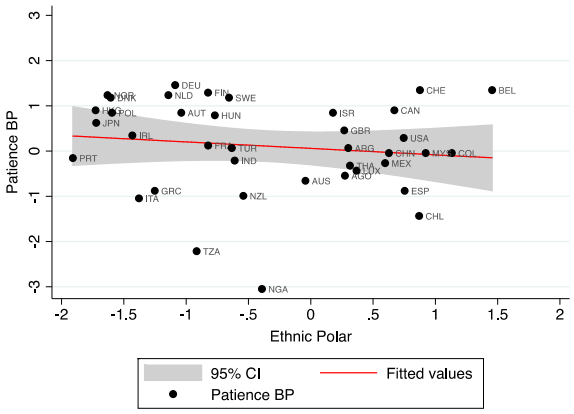
c.3.- Ethnic Segregation



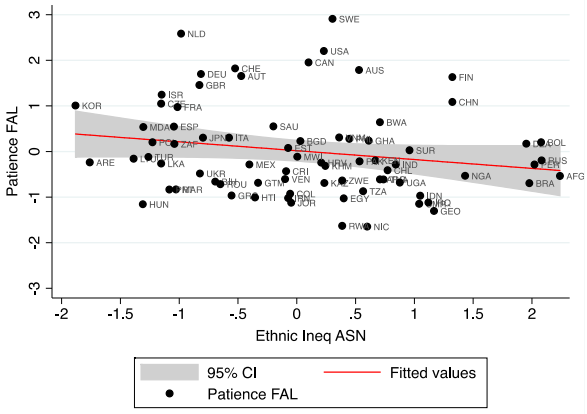


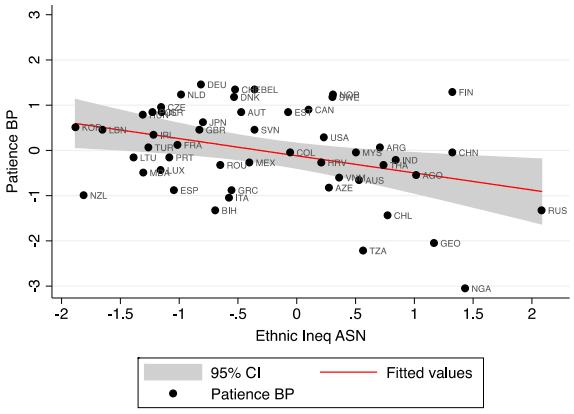
c.4.- Ethnic Polar



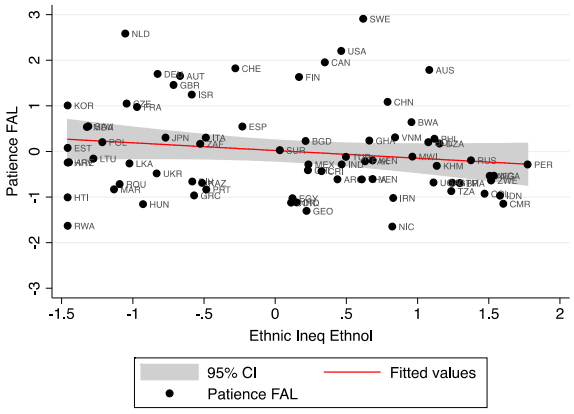


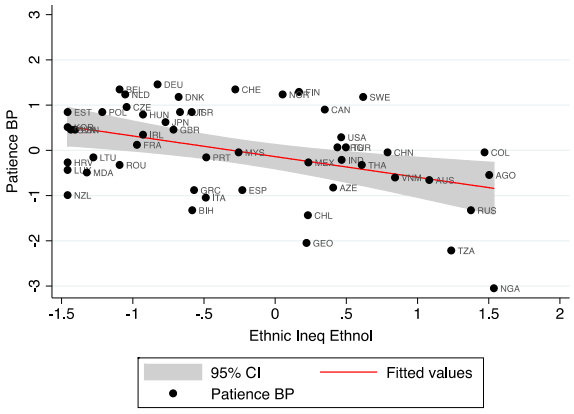
c.5.- Ethnic Ineq ASN





c.6.- Ethnic Ineq Ethnol





Country Data

Country	Patience FAL.	Patience BP.	Group Grievance	Life Expec.	Infant Mortality Rate.	GDPpc.	Ethnic Frac AAL.	Ethnic Frac MRQ.	Ethnic Segr.	Ethnic Polar.	Ethnic Ineq ASN.	Ethnic Ineq Ethnol.
Afghanistan	-0.201	null	9.700	61.265	90.000	553.30	0.769	0.603	0.373	0.786	0.950	0.901
Algeria	0.060	null	8.200	74.700	27.400	4463.39	0.339	0.299	null	0.514	0.884	0.794
Angola	null	0.530	5.900	58.207	121.300	3531.42	0.787	0.805	null	0.572	0.668	0.900
Argentina	-0.229	0.640	4.500	75.586	14.500	10276.30	0.255	0.408	0.012	0.579	0.597	0.576
Australia	0.657	0.510	3.400	81.750	4.800	51936.90	0.093	0.315	0.067	0.492	0.556	0.772
Austria	0.608	0.780	3.800	80.650	4.300	46858.00	0.107	0.128	0.011	0.240	0.325	0.240
Azerbaijan	null	0.480	7.900	70.995	37.400	5842.81	0.205	null	null	null	0.497	0.567
Bangladesh	0.081	null	8.900	70.273	49.200	757.67	0.045	0.068	0.005	0.132	0.441	0.508
Belgium	null	0.870	4.400	80.250	4.500	44380.20	0.555	0.544	0.203	0.871	0.351	0.111
Bolivia	0.071	null	7.700	66.464	46.000	1981.16	0.740	0.708	0.075	0.767	0.913	0.770
Bosnia-Herzegov.	-0.247	0.390	8.700	75.857	7.200	4614.83	0.630	null	null	null	0.274	0.266
Botswana	0.234	null	4.100	59.846	49.900	6346.16	0.410	0.485	null	0.650	0.597	0.734
Brazil	-0.260	null	6.200	73.861	18.700	11224.20	0.541	0.644	0.047	0.773	0.890	0.837
Cambodia	-0.120	null	6.900	66.473	44.400	785.69	0.211	null	0.009	null	0.490	0.788
Cameroon	-0.427	null	7.500	55.429	110.400	1309.12	0.864	0.817	0.042	0.576	0.674	0.930
Canada	0.718	0.790	3.100	81.250	5.600	47447.50	0.712	0.767	0.006	0.672	0.457	0.549
Chile	-0.155	0.370	3.400	78.374	8.800	12860.20	0.186	0.432	0.022	0.723	0.612	0.513
China	0.398	0.620	8.000	75.304	15.800	4560.51	0.154	0.599	0.085	0.661	0.739	0.683
Colombia	-0.346	0.620	7.200	73.372	18.500	6250.66	0.601	0.675	0.280	0.789	0.421	0.890
Costa Rica	-0.163	null	3.900	78.793	10.000	8199.42	0.237	0.241	0.044	0.420	0.413	0.542
Croatia	-0.094	0.580	5.200	76.550	5.500	13542.90	0.369	null	0.008	null	0.482	0.000
Czech Republic	0.384	0.800	3.400	77.500	3.400	19808.10	0.322	null	0.004	null	0.168	0.126
Denmark	null	0.840	3.000	79.150	4.100	58041.40	0.082	0.049	0.024	0.097	0.311	0.237
Egypt	-0.383	null	8.200	70.396	29.000	2602.48	0.184	0.247	null	0.427	0.526	0.480
Estonia	0.025	0.780	5.000	75.550	4.500	14638.60	0.506	null	0.018	null	0.417	0.000
Finland	0.600	0.860	1.200	79.950	3.000	46202.40	0.132	0.148	0.064	0.294	0.739	0.494
France	0.357	0.650	5.600	81.750	4.200	40638.30	0.103	0.147	0.020	0.294	0.200	0.148
Georgia	-0.485	0.260	8.400	72.599	16.600	2964.48	0.492	null	null	null	0.703	0.510
Germany	0.624	0.890	4.700	80.050	4.200	41785.60	0.168	0.123	0.001	0.227	0.246	0.192
Ghana	0.085	null	5.200	60.916	72.400	1312.61	0.673	0.731	0.112	0.661	0.575	0.644
Greece	-0.360	0.470	4.200	80.450	3.900	26917.80	0.158	0.099	0.002	0.186	0.306	0.270
Guatemala	-0.257	null	6.800	71.465	35.400	2825.52	0.512	0.520	0.384	0.955	0.358	0.821
Haiti	-0.376	null	7.300	61.304	83.500	662.28	0.095	0.104	null	0.207	0.352	0.000
Hong Kong	null	0.790	null	83.050	null	32550.00	0.062	0.034	null	0.066	null	null
Hungary	-0.431	0.770	3.200	74.300	6.000	13092.20	0.152	0.167	0.003	0.308	0.132	0.161
India	-0.109	0.590	7.800	66.669	58.400	1345.77	0.418	0.901	0.090	0.348	0.628	0.585
Indonesia	-0.362	null	6.300	68.204	33.200	3113.48	0.735	0.793	0.179	0.529	0.676	0.923
Iran	-0.381	null	8.100	73.993	19.600	6531.93	0.668	0.756	null	0.598	0.417	0.695
Iraq	-0.417	null	9.300	68.548	36.900	4502.75	0.369	0.390	null	0.665	0.692	0.489
Ireland	null	0.690	1.000	80.800	4.200	48671.90	0.121	0.072	0.003	0.141	0.153	0.161
Israel	0.457	0.780	9.500	81.650	4.600	30642.90	0.344	0.286	0.191	0.548	0.169	0.265
Italy	0.108	0.440	4.800	82.100	4.000	35849.40	0.115	0.080	0.006	0.154	0.301	0.295

Japan	0.108	0.740	3.600	82.925	3.200	44507.70	0.012	0.034	0.002	0.067	0.250	0.209
Jordan	-0.418	null	6.900	73.478	21.100	3679.19	0.593	0.515	0.019	0.982	0.423	0.477
Kazakhstan	-0.259	null	5.700	68.415	20.400	9070.49	0.617	null	0.028	null	0.488	0.287
Kenya	-0.076	null	8.900	62.936	58.400	967.35	0.859	0.890	0.235	0.381	0.588	0.651
Lebanon	null	0.710	9.000	78.583	10.300	8858.28	0.131	null	null	null	0.053	0.016
Lithuania	-0.062	0.600	4.000	73.400	6.000	11984.90	0.322	null	0.052	null	0.114	0.055
Luxemb.	null	0.550	3.200	80.700	3.000	104965.0	0.530	0.298	null	0.596	0.167	0.000
Malawi	-0.046	null	6.200	57.208	88.600	458.87	0.674	0.684	null	0.762	0.435	0.736
Malaysia	null	0.620	6.600	74.343	7.700	9071.36	0.588	0.695	0.023	0.736	0.550	0.365
Mexico	-0.108	0.580	5.800	76.093	17.300	9016.46	0.542	0.576	0.160	0.654	0.341	0.514
Moldova	0.195	0.540	6.900	69.609	17.200	1631.54	0.554	null	null	null	0.133	0.041
Morocco	-0.311	null	6.600	73.974	32.000	2834.20	0.484	0.475	0.253	0.897	0.197	0.099
Netherlands	0.952	0.850	4.700	80.750	4.400	50338.30	0.105	0.113	0.001	0.214	0.207	0.123
New Zealand	null	0.450	3.300	80.750	6.200	33692.00	0.397	0.196	0.042	0.366	0.016	0.000
Nicaragua	-0.613	null	6.300	73.667	22.600	1526.50	0.484	0.496	null	0.681	0.572	0.693
Nigeria	-0.200	0.080	9.500	50.855	129.600	2327.32	0.851	0.885	null	0.404	0.764	0.910
Norway	null	0.850	1.300	81.050	3.200	87770.30	0.059	0.045	0.022	0.090	0.505	0.459
Pakistan	-0.083	null	9.400	65.173	90.800	1040.14	0.710	0.608	0.316	0.698	0.557	0.635
Peru	-0.109	null	6.700	73.717	20.300	5022.49	0.657	0.658	0.169	0.817	0.900	0.982
Philippines	0.099	null	7.600	68.440	31.300	2129.50	0.239	0.843	0.119	0.497	0.537	0.783
Poland	0.072	0.780	3.300	76.350	6.000	12599.50	0.118	0.051	null	0.099	0.151	0.074
Portugal	-0.312	0.600	2.600	79.100	3.900	22538.70	0.047	0.010	0.015	0.020	0.184	0.296
Romania	-0.268	0.570	5.600	73.550	11.500	8231.31	0.307	null	0.018	null	0.284	0.111
Russia	-0.075	0.390	7.100	68.985	10.400	10675.00	0.245	null	0.155	null	0.914	0.861
Rwanda	-0.606	null	8.500	63.109	64.400	563.40	0.324	0.221	0.011	0.401	0.523	0.000
Saudi Arabia	0.200	null	7.800	73.736	12.000	19259.60	0.180	0.059	0.041	0.114	0.388	0.044
Serbia	-0.138	null	7.800	74.400	7.600	5411.88	0.574	null	null	null	null	null
Slovenia	null	0.710	3.400	79.500	3.200	23437.50	0.222	null	0.003	null	0.351	0.007
South Africa	0.058	null	5.600	55.941	59.300	7275.38	0.752	0.469	0.247	0.718	0.194	0.283
South Korea	0.369	0.720	3.900	80.200	4.100	22087.00	0.039	0.014	0.002	null	0.000	0.000
Spain	0.198	0.470	6.300	81.700	3.800	30736.60	0.417	0.436	0.244	0.693	0.193	0.373
Sri Lanka	-0.101	null	9.600	74.398	11.600	2808.55	0.415	0.452	0.021	0.749	0.168	0.132
Suriname	0.007	null	6.400	70.444	24.600	8303.31	0.733	0.729	null	0.734	0.655	0.453
Sweden	1.071	0.840	1.300	81.500	3.000	52076.30	0.060	0.189	0.001	0.337	0.504	0.631
Switzerland	0.670	0.870	3.300	82.300	4.600	74605.70	0.531	0.560	0.088	0.724	0.313	0.358
Tanzania	-0.325	0.230	6.400	60.896	73.400	701.61	0.735	0.959	0.141	0.271	0.564	0.819
Thailand	-0.230	0.570	7.800	73.982	13.300	5075.30	0.634	0.361	null	0.582	0.604	0.628
Turkey	-0.047	0.640	8.000	74.177	19.200	10672.40	0.320	0.185	0.357	0.342	0.143	0.594
Uganda	-0.255	null	8.500	57.121	78.000	595.21	0.930	0.932	0.371	0.279	0.636	0.781
Ukraine	-0.182	null	6.900	70.390	11.700	2965.14	0.474	null	0.025	null	0.244	0.190
United Arab Emirates	-0.091	null	4.700	76.721	8.400	35037.90	0.625	0.320	null	0.640	0.028	0.003
United Kingdom	0.535	0.710	4.100	80.450	5.200	38893.00	0.121	0.373	0.026	0.571	0.243	0.226
U.S.A.	0.811	0.680	3.400	78.600	7.300	48375.40	0.490	0.583	0.011	0.691	0.487	0.584
Vietnam	0.111	0.520	5.300	75.090	22.900	1310.37	0.238	null	0.037	null	0.517	0.699
Venezuela	-0.227	null	6.800	73.777	16.600	13545.30	0.497	0.539	null	0.758	0.411	0.651
Zimbabwe	-0.239	null	8.800	52.908	87.500	719.98	0.387	0.534	0.394	0.698	0.523	0.904