UNIVERSIDAD LOYOLA ANDALUCÍA

TESIS DOCTORAL

"The evolution of strategical thinking in adolescence and its relation with cognitive abilities"

Doctorando/a:	Pablo Montero Lomas
Directores:	Pablo Ernesto Brañas Garza
	Diego Andrés Jorrat
Tutor/a de Doctorado:	Alfonso Carlos Martínez Estudillo

- Mención de Doctorado Internacional

Córdoba, 2026

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Universidad LOYOLA

The evolution of strategical thinking in adolescence and its relation with cognitive abilities

Pablo Montero Lomas

A dissertation submitted in fulfillment

of the requirements for the degree of

Doctor of Data Science

of

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Department of Economics

Universidad Loyola Andalucía

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I, Pablo Montero Lomas, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the work.

Por creer en mí,

Por el ángel que me cuida,

Por las noches en vela,

Porque siempre mereció la pena.

A mis padres y allegados, que me dieron todo a cambio de nada.

Pablo Montero Lomas

"La pureza no se puede perder nunca cuando uno la lleva dentro de verdad, ¿no?

Entonces... Lo único que veo que la gente no me comprende como yo canto.

Mi manera de sentir todavía la gente no la ha entendido.

Entonces, yo no le echo cuenta, yo voy a mi aire"

Camarón de la Isla

Abstract

This thesis contributes to the literature on economic experiments with adolescents and their capacity for strategic thinking by exploring its relationship with cognitive ability, age, different types of incentives, and potential differences arising from the use of diverse experimental designs. A particularly distinctive feature of this thesis is the study of the evolution of strategic thinking between ages 10 and 20, providing evidence on how individuals' ability to anticipate others evolves over time.

The studies are based on data collected between 2021 and 2024 using two types of experiments: laboratory experiments and lab-in-the-field experiments. The laboratory experiments were conducted with university students and older adolescents, while the lab-in-the-field experiments were carried out in 33 secondary schools in Spain. The tasks used to measure strategic thinking are the same across all samples, which allows for direct comparisons. These tasks are based on standard designs used with adult populations, but were adapted to be easier to understand for younger participants using more visual and interactive formats. In addition to these measures of strategic thinking, information was collected from other experimental tasks, including cognitive ability, time and risk preferences, as well as sociodemographic characteristics.

Chapters 3, 4 and 5 use subsamples from the full dataset to conduct analyses of strategic thinking in adolescents.

A summary of each chapter follows.

Chapter 3: This chapter examines how age and cognitive ability are related to best-response play in payoff-dominant and risk-dominant coordination games. Combining two complementary studies: a lab-in-the-field experiment in Spanish secondary schools (Study 1, n = 1,716, ages 10–17) and a laboratory experiment at Universidad Loyola Andalucía with high-school visitors and university students (Study 2, n = 415, ages 17–20). We obtained a total sample of 2,131 subjects spanning late childhood, adolescence, and early adulthood. Participants played a coordination game in which they chose between two actions by pressing one of two buttons. They subsequently selected the reason for pressing the chosen button to explain their choice. Participants also completed three cognitive ability tests: a Cognitive Reflection Test (CRT), a three-question test in mathematics and finance, and an additional test assessing understanding of basic probability concepts and their application. Using both the chosen action and the stated argument, two outcome variables were constructed to capture deliberate payoff-based coordination and deliberate risk-based coordination in each game. The results show a clear asymmetry between the two coordination principles across age groups. Payoff-based coordination is already common at the earliest ages and remains stable across age groups, with similar patterns across cognitive ability and gender groups. In contrast, risk-based coordination increases with age. This pattern is heterogeneous: it is mainly observed among high-ability individuals and is largely driven by males, while low-ability individuals and females show flatter age profiles. These findings suggest that coordination is not uniform across age groups and that sensitivity to strategic uncertainty increases with age, rather than being present from early ages. They also indicate that similar coordination outcomes may arise from different underlying mechanisms.

Chapter 4: This chapter presents results on the role of monetary versus hypothetical incentives in strategic thinking under coordination in Nash equilibrium. Two studies (n = 242 and n = 301) were conducted with high-school visitors and university students. Participants played the two coordination games designed in the previous chapter (one with a payoff-dominant equilibrium and another with a risk-dominant

equilibrium) and were randomly assigned at the individual level to either a monetary or a hypothetical payment scheme. Their strategic decisions and the arguments selected to justify those decisions were then examined. The results show that the use of monetary versus hypothetical payment schemes has no effect on strategic thinking performance, either on the chosen action or on the deliberate use of payoff- or risk-based reasoning. In Study 2, the order in which the two games were presented was additionally randomized, and game order was also found to have no effect on the frequency playing the best response in coordination games. These findings suggest that, in this class of one-shot 2×2 coordination games, monetary incentives are not necessary to elicit reliable strategic behavior.

Chapter 5: This chapter analyzes how cognitive abilities are related to strategic behaviour in static and dynamic strategic environments adapted to adolescent populations, drawing on two experimental designs (with samples of 2,718 and 653 subjects, respectively). Using two adapted two-player games: a static one based on the Beauty Contest Game (CARDS), and a dynamic accumulation game based on the Chicken Game and the War of Attrition framework (PIGGY). This chapter presents results on the selection of best responses related to cognition. As outcome variables, we include not only measures capturing Nash equilibrium play but also measures related to deviation (*Trembling*) and accuracy (*Rationality*). Cognitive skills were constructed through a composite index based on three instruments (the same used in Chapter 3): a Cognitive Reflection Test (CRT), a mathematics and finance skills test, and a set of probability knowledge questions. Participants also completed two additional tasks eliciting intertemporal preferences and risk attitudes. The results show that participants play the Nash equilibrium more frequently in the adapted Beauty Contest Game (CARDS) than in the dynamic accumulation game (PIGGY). Moreover, although cognitive skills are significant predictors of strategic thinking in both experimental designs, they are more sensitive predictors of strategic behaviour in PIGGY than in CARDS, particularly with respect to the *Rationality* (accuracy) outcome. Finally, no age effect is found on players' ability to make optimal decisions.

The combination of these findings contributes to the design of experimental research on strategic thinking in adolescents, facilitating the study of its relationship with key variables in cognitive development, such as cognitive ability and age. In turn, this may help inform interventions aimed at improving academic performance in these age groups.

Resumen

La presente tesis contribuye a la literatura sobre experimentos económicos con adolescentes y su capacidad de pensamiento estratégico, explorando su relación con la capacidad cognitiva, la edad, distintos tipos de incentivos y las posibles diferencias derivadas del uso de diversos diseños experimentales. Un rasgo particularmente distintivo de esta tesis es el estudio de la evolución del pensamiento estratégico entre los 10 y los 20 años, aportando evidencia sobre cómo evoluciona con el tiempo la capacidad de los individuos para anticipar el comportamiento de los demás.

Los estudios se basan en datos recopilados entre 2021 y 2024 utilizando dos tipos de experimentos: experimentos de laboratorio y experimentos lab-in-the-field. Los experimentos de laboratorio se realizaron con estudiantes universitarios y adolescentes mayores, mientras que los experimentos lab-in-the-field se llevaron a cabo en 33 centros de educación secundaria en España. Las tareas utilizadas para medir el pensamiento estratégico son las mismas en todas las muestras, lo que permite realizar comparaciones directas. Estas tareas se basan en diseños estándar utilizados con poblaciones adultas, pero fueron adaptadas para facilitar su comprensión por parte de participantes más jóvenes mediante formatos más visuales e interactivos. Además de estas medidas de pensamiento estratégico, se recopiló información procedente de otras tareas experimentales, incluyendo capacidad cognitiva, preferencias temporales y de riesgo, así como características sociodemográficas.

Los Capítulos 3, 4 y 5 utilizan submuestras del conjunto completo de datos para realizar análisis sobre el pensamiento estratégico en adolescentes.

A continuación, se presenta un resumen de cada capítulo.

Capítulo 3: Este capítulo examina cómo la edad y la capacidad cognitiva se relacionan con el juego de mejores respuestas en juegos de coordinación con dominancia en pagos (*payoff-dominance*) y en riesgo (*risk-dominance*). Combinando dos estudios complementarios—un experimento lab-in-the-field realizado en centros de

educación secundaria españoles (Estudio 1, n = 1.716, edades 10–17) y un experimento de laboratorio realizado en la Universidad Loyola Andalucía con visitantes de bachillerato y estudiantes universitarios (Estudio 2, n = 415, edades 17–20)—se obtuvo una muestra total de 2.131 sujetos que abarca la infancia tardía, la adolescencia y la adultez temprana. Los participantes jugaron un juego de coordinación en el que elegían entre dos acciones pulsando uno de dos botones. Posteriormente, seleccionaban la razón de haber pulsado el botón elegido para explicar su decisión. Los participantes también completaron tres pruebas de capacidad cognitiva: un Test de Reflexión Cognitiva (CRT), una prueba de tres preguntas sobre matemáticas y finanzas, y una prueba adicional que evaluaba la comprensión de conceptos básicos de probabilidad y su aplicación. Utilizando tanto la acción elegida como el argumento declarado, se construyeron dos variables para capturar la coordinación deliberada basada en pagos y la coordinación deliberada basada en riesgo en cada juego. Los resultados muestran una clara asimetría entre los dos principios de coordinación según los grupos de edad. La coordinación basada en pagos ya es frecuente en las edades más tempranas y permanece estable entre grupos de edad, con patrones similares entre grupos según capacidad cognitiva y género. En contraste, la coordinación basada en riesgo aumenta con la edad. Este patrón es heterogéneo: se observa principalmente entre individuos con alta capacidad cognitiva y está impulsado en gran medida por los hombres, mientras que los individuos con baja capacidad cognitiva y las mujeres muestran perfiles de edad más planos. Estos resultados sugieren que la coordinación no es uniforme entre grupos de edad y que la sensibilidad a la incertidumbre estratégica aumenta con la edad, en lugar de estar presente desde edades tempranas. Asimismo, indican que resultados similares de coordinación pueden surgir de mecanismos subyacentes diferentes.

Capítulo 4: Este capítulo presenta resultados sobre el papel de los incentivos monetarios frente a los hipotéticos en el pensamiento estratégico bajo coordinación. Se llevaron a cabo dos estudios (n = 242 y n = 301) con visitantes de bachillerato y estudiantes universitarios. Los participantes jugaron los dos juegos de coordinación diseñados en el capítulo anterior (uno con un equilibrio dominante en pagos

y otro con un equilibrio dominante en riesgo) y fueron asignados aleatoriamente, a nivel individual, a un esquema de pago monetario o hipotético. Posteriormente, se examinaron sus decisiones estratégicas y los argumentos seleccionados para justificar dichas decisiones. Los resultados muestran que el uso de esquemas de pago monetarios frente a hipotéticos no tiene efecto sobre el desempeño del pensamiento estratégico, ni sobre la acción elegida ni sobre el uso deliberado del razonamiento basado en pagos o en riesgo. En el Estudio 2, además, se aleatorizó el orden en que se presentaban los dos juegos, y también se encontró que el orden de los juegos no tiene efecto sobre los resultados. Estos hallazgos sugieren que, en esta clase de juegos de coordinación 2×2 de una sola ronda, los incentivos monetarios no son necesarios para obtener un comportamiento estratégico fiable.

Capítulo 5: Este capítulo analiza cómo las habilidades cognitivas se relacionan con el comportamiento estratégico en entornos estratégicos estáticos y dinámicos adaptados a población adolescente, a partir de dos diseños experimentales (con muestras de 2.718 y 653 sujetos). Utilizando dos juegos adaptados para dos jugadores: uno estático basado en el Beauty Contest Game (CARDS), y otro juego dinámico de acumulación basado en el Chicken Game y el marco de la War of Attrition (PIGGY). Este capítulo presenta resultados sobre la selección de mejores respuestas relacionadas con la cognición. Como variables dependientes del estudio, incluimos no solo medidas que capturan el juego de equilibrio de Nash, sino también medidas relacionadas con la desviación (*Trembling*) y la precisión (*Rationality*). Las habilidades cognitivas se construyeron mediante un índice compuesto basado en tres instrumentos (los mismos utilizados en el Capítulo 3): un Test de Reflexión Cognitiva (CRT), una prueba de habilidades matemáticas y financieras, y un conjunto de preguntas sobre conocimiento de probabilidades. Los participantes también completaron dos tareas adicionales para elicitar preferencias intertemporales y actitudes hacia el riesgo. Los resultados muestran que los participantes juegan el equilibrio de Nash con mayor frecuencia en la versión adaptada del Beauty Contest Game (CARDS) que en el juego dinámico de acumulación (PIGGY). Además, aunque las habilidades cognitivas son predictores significativos del pensamiento estratégico en

ambos diseños experimentales, son predictores más sensibles del comportamiento estratégico en PIGGY que en CARDS, particularmente respecto al resultado de *Rationality* (precisión). Finalmente, no se encuentra ningún efecto de la edad sobre la capacidad de los jugadores para tomar decisiones óptimas.

La combinación de estos hallazgos contribuye al diseño de investigaciones experimentales sobre el pensamiento estratégico en adolescentes, facilitando el estudio de su relación con variables clave del desarrollo cognitivo, como la capacidad cognitiva y la edad. A su vez, esto puede ayudar a orientar intervenciones destinadas a mejorar el rendimiento académico en estos grupos de edad.

Acknowledgements

Agradecimientos

Y si me preguntasen si volvería a repetirlo, diría que lo volvería a hacer con los ojos cerrados.

Que yo esté firmando este papel es el culmen a cinco años de *aventuras*. Cinco años desde que recibí aquel correo electrónico inesperado de mi profesor de Málaga (hay gente que sigue empeñando en pensar que soy malagueño y no gaditano), D. Javier Rodero Cosano, en el que me preguntaba si estaba interesado en trabajar en un proyecto de investigación. Todo esto, según tengo entendido, llegó porque él le consultó primero a una compañera de mi carrera sobre quién estaría interesado en ocupar el puesto, y esta compañera dio mi nombre. A veces, con un nombre, la vida cambia. *Dicen que por mucho que niegues la existencia de Dios, Él te sigue queriendo.*

Fue un 5 de julio de 2021. En aquel entonces vivía en un piso de la zona de Huelín de la ciudad de Málaga y, como en todas las cosas que hago en la vida, dije que sí sin preguntar (*y sin pensar demasiado*). No sabía dónde me estaba metiendo. No sabía cuánto iba a cobrar. No sabía cuánto iba a trabajar. No sabía ni dónde era. Pero dije que sí sin preguntar. Dije que sí porque, no sé cómo lo hago, digo que sí sabiendo que las cosas saldrán bien. Porque a veces me siento tocado por una varita.

Me caracterizo por ser una persona desafiante, alocada, ambiciosa y con ganas por disfrutar de todo lo que me apasiona. Aquel 5 de julio de 2021 lo cierto es que no

tenía ni idea a lo que estaba diciendo que *sí*. Pero, *si me preguntasen si volvería a repetirlo, diría que lo volvería a hacer con los ojos cerrados*.

Fue el 6 de septiembre de 2021, en medio del campus de Dos Hermanas de la Universidad Loyola y con mascarillas de por medio, cuando conocí en persona al profesor D. Pablo Ernesto Brañas Garza. Mi mayor mentor. Una persona a la que le diría que le debo todo lo que he conseguido desde esa fecha hasta ahora. Y, también, todo lo que vendrá después, aunque nadie sabe lo que vendrá (*y eso es lo bonito de vivir*). Él no lo sabe y probablemente se entere leyendo esto, pero cuando lo conocí yo ya le admiraba muchísimo a nivel profesional por toda su investigación. Ahora, después de 5 años, le admiro mucho más, pero por cosas personales que he visto en él. Recuerdo esa mañana del 6 de septiembre de 2021 ir en mi Peugeot 406 (*no era mío realmente, sino de mi padre*) desde Córdoba hasta Dos Hermanas para conocerlo y hablar de lo que era el famoso *"Proyecto de los Coles"*. Tanto él como yo lo teníamos claro: *íbamos a triunfar como la Coca-Cola*.

Ahí empecé a conocer y a aprender del *Loyola Behavioral Lab*. Conocí seguidamente a mi co-director de tesis, D. Diego Andrés Jorrat, que me enseñaba clases exprés de econometría y Stata, y que gracias a él le debo también la mayor parte de lo que hemos conseguido. Pero, sobre todo, le debo que me haya enseñado a ser una persona calmada cuando el estrés me comía por dentro y me sentía desolado. Le debo, tanto a él como a Pablo, haberme motivado cuando pensaba en dejarlo y haberme convencido de que esto que ahora mismo estáis leyendo aquí era posible.

Posteriormente, tuve otros mentores que me ayudaron a allanar el camino, como fue el caso de D. Antonio Alfonso que, con su labia y su gran inteligencia, me dejaba claro que estaba rodeado de auténticos genios y que, con muy poco, podíamos llegar a hacer grandes cosas. A todo ello se unió la Fundación ETEA, donde personas tan maravillosas como María José, Lorenzo, Manuela o Alicia me ayudaron en todo lo que pudieron y nunca pusieron un "*pero*çuando de verdad les necesitaba. La dirección de José Manuel y la gran colaboración de personas como Michela también fueron determinantes. Al final, la Fundación siento que fue mi casa, aunque allí yo

fuese un fantasma (*o eso me decían*).

De ahí se pasó a la aventura tan *hip-hopera* de ir a El Salvador a correr experimentos, teniendo que terminar un Máster, asistiendo a clases virtuales y con un estado de alarma declarado de por medio por Bukele en 2022, con nosotros allí ya corriendo experimentos por todo el país. Pero esta vivencia fue la mejor experiencia de mi vida. Sobre todo, porque la viví con la que considero que es mi hermana de la que me separaron al nacer: Gladis Herminia Gonzales Aguilar. ¿Qué podría decir de Gladis? Jamás podría decir lo suficiente para mostrar lo buena persona que es, lo infinitamente feliz que me hace los ratos que paso con ella y las grandes risas que nos hemos echado desde que la pude ver por primera vez en aquella clase virtual del Máster comiéndose un dulce de chocolate y cuando le dije por chat *"que aproveche"*.

Luego llegó el turno de conocer a personas tan alocadas y entusiastas como Mónica Vasco, donde nada más vernos en persona por primera vez fuimos a correr experimentos a Granada (*en el Peugeot 406 de mi padre, evidentemente*), y hasta entonces hemos vivido fiestas, congresos y seminarios. Pasamos por Exeter, luego por Niza y luego recorriendo las provincias de Cádiz, Sevilla y Badajoz. Gracias Mónica por siempre ayudarme en todo y por ser, además de una excepcional compañera de trabajo, una gran amiga.

Entre medias también tuve la oportunidad de conocer sitios tan recónditos como Costa de Marfil o Copenhague (*aunque tengo la espinita de haberme perdido Madagascar, ya que yo siempre me apunto a un buen bombardeo*). Pero eso mejor que os lo cuente Pablo AKA "*el jefazo*", que yo ya estoy hablando demasiado.

Dentro de la Universidad Loyola conocí a personas a las que siempre guardaré en mi corazón: Alazne, Sara, José Manuel, Mila, Cristina, Mapi, Javi (*cómics*), Fanilo, Ignacio... Con todos ellos tuve momentos realmente especiales, frases que me marcaron o, simplemente, me ayudaron a sacar una sonrisa en los momentos de comida en la cafetería, donde Luis siempre nos reñía por pedir el café colándonos en la cola

después de haber tomado el menú.

A Javi y a Fanilo siempre les recordaré por aquel workshop en Soleto en julio de 2023. Como dirían los colombianos *"Soleto es Soleto, lo demás es loma"*. Uso una referencia colombiana para mencionar efectivamente a mi gran *Field Coordinator* Adriana Gaviria, a la que le debo muchas cosas, como mi nivel actual en Qualtrics, o que ella sola me haya conseguido gran parte de la muestra del cuarto capítulo de esta tesis. También le debo que ahora el café se haya convertido en un ritual en mi vida.

Si de colombianos va la cosa, tampoco me olvidaría de los comentarios y aportaciones de César Mantilla, y al que se le unen investigadores realmente lúcidos, agradables y perspicaces como Filippos Exadaktylos, Teresa García, Patricia Román, Alfonso Carlos Martínez, Juan Carrillo, Isabelle Brocas, Antonio Cabrales, Anxo Sánchez, Àlex Izquierdo o Daniel Montolio. Todos ellos han formado parte de una gran investigación de la que un pedacito es esta tesis que se expone en las siguientes páginas.

Luego existen otras personas a las que me gustaría mencionar y que, probablemente, nadie relacionado con la Universidad Loyola conozca (*¿o si?*). Pero mi actitud ante la vida nunca habría podido ser la misma sin las lecciones de mi sensei Juan Trigo (*i - "si te golpean, responde"; ii - .*^{en} *esta vida, o se gana o se aprende"*), sin las risas en la carrera con Anabel Rojas y sin los momentos más divertidos del grupo Coffee de Córdoba (Anabel, Bego, Alberto et al.). Y siempre estaré eternamente agradecido a Codenaf (a Salima, Narjis, Noe, Adel y Fauossi), por demostrarme que un mundo mejor es posible. Pocos lo saben, pero todo en mi vida cambió cuando un día de 2019 fui a una ONG pequeñita en la zona de Trinidad de Málaga, donde les comenté que quería trabajar en proyectos al desarrollo y que me ofrecía a hacer mis prácticas de la carrera con ellos (*gratis, evidentemente*). Luego, la vida me lo devolvió pudiendo hacer un Trabajo Fin de Grado basado en la Economía del Comportamiento, observando diferencias entre población local e inmigrante, dirigido por Javier Rodero Cosano y José Manuel Ordóñez de Haro. El resto, es historia.

De oportunidades está llena la vida. Y todas las personas mencionadas anteriormente me dieron la oportunidad de llegar hasta aquí, de cumplir un sueño o, mejor dicho, de vivirlo mientras se cumplía (*porque lo importante en la vida no es el fin, sino el camino*). Entiendo que haya habido personas que directamente nunca entendieron por qué le dedicaba tantos esfuerzos a un Trabajo Fin de Grado, a trabajar gratis para una ONG de Málaga que nadie conocía, a irme a vivir a Córdoba a trabajar en algo que no sabía ni lo que era, a trabajar fines de semana (uno tras otro), a tener muy pocas vacaciones, a estar pendiente siempre de todo, a ver poco a la familia, o incluso a poner por delante mi trabajo antes que relaciones personales (*perdóname abuelo Pepe por no haberme podido despedirme de ti porque estaba en El Salvador, y perdóname M por, quizás, descuidar nuestro amor por haber querido recorrer mundo*).

Son cosas que sé que muy pocas personas entenderán. Cuando a alguien le gusta mucho algo de verdad, está dispuesto a hacer lo que sea para poder conseguirlo y vivir de ello. *La pasión, la pasión es algo que no se puede perder nunca cuando uno la lleva dentro de verdad, ¿no?* Creo que esa es un poco mi mayor virtud: ser alguien pasional. *Porque la belleza no está en la vida, sino en los ojos del que la mira*.

De hecho, en algún momento llegué a pensar que jamás llegaría a cabar esta tesis, que abandonaría y que esto nunca vería la luz. Pero, a veces, la vida te sorprende. La vida te puede dar una vuelta de 180 grados en un mismo día. Por conocer a alguien, o simplemente por acudir a algún sitio. Y quería dejar como último agradecimiento final al profesor Giuseppe Attanasi, por haberme permitido realizar ese "*the last dance*"de movilidad internacional en Italia (volviendo a los orígenes de Soleto) y a los comentarios y a la atención recibida especialmente por la profesora Natalia Jiménez Jiménez, que ayudaron, sobre todo, a mejorar considerablemente el Capítulo 5 de esta tesis.

La financiación y los fondos son muy importantes en la investigación. Así que agradezco, además, a quienes han financiado esta tesis, como son la Agencia Anda-

luza de Cooperación Internacional para el Desarrollo (2021UI004), el Ministerio Español de Economía y Competitividad (PID2021-126892NB-100) y el proyecto Europeo SustainWell (HORIZON-101095175). Sin ellos, jamás habría podido recorrer Andalucía, Extremadura y El Salvador en búsqueda de datos y colegios. Lo reconozco, me encantó la parte de sentirme como un auténtico *rockstar* (*en el Peugeot 406 de mi padre, aunque ahora a veces recorro España en el modelo 2008, también de mi padre claro*).

Dicen que lo mejor se deja para el final, y por ello siempre diré que mis padres lo son todo para mí. Natividad y Manuel, que siempre me dieron todo a cambio de nada (*¿seré capaz algún día de poder devolverles al menos un 1 % de lo que me han dado?*). Mi hermana, Marta, que siempre se encuentra lejos pero presente conmigo, a la que echo tanto de menos. *Os quiero mucho, tanto como de aquí a Roma (o a Australia)*.

No podía cerrar este trabajo sin una referencia a algo del rap (*ya me conocéis*). Y es que un gran rapero (o *poeta*) de Zaragoza ciudad dijo que lo más importante en la vida es *perdonar y agradecer*. Espero que todos a los que he mencionado más arriba me perdonen por haber sido muy terco muchas veces, o por no haber podido estar a la altura en ciertos momentos. A cambio, yo les agradezco con todo mi corazón que me hayan ayudado a cumplir un sueño.

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Chapter 1

Introducción

Tradicionalmente, la toma de decisiones se ha estudiado mediante experimentos de laboratorio, en los que participan principalmente adultos, sobre todo estudiantes universitarios que participan de forma voluntaria en estos experimentos (Exadaktylos et al., 2013). A partir del trabajo de Harbaugh et al. (2001), la atención ha comenzado a desplazarse hacia poblaciones más jóvenes, con un interés creciente por parte de los economistas en el estudio de individuos no adultos (List et al., 2023; Brocas y Carrillo, 2020b).

Estudiar el comportamiento en la población no adulta ayuda a comprender el desarrollo cognitivo y potencialmente arroja luz sobre la formación de preferencias y comportamientos. Hay que recordar que los niños y adolescentes están descubriendo gradualmente los peligros que se esconden tras las interacciones sociales y deben saber cómo detectarlos. Tomar buenas decisiones en estos entornos requiere comprender las intenciones de las personas y anticipar las consecuencias.

Precisamente, la sofisticación estratégica se refiere a la capacidad de anticipar el comportamiento de los demás. Por ello, analizar el pensamiento estratégico en distintas etapas del desarrollo cognitivo resulta clave para comprender cómo evolucionan las decisiones en contextos sociales. Asimismo, entender la toma de decisiones en la población joven puede contribuir al diseño de incentivos que ayuden a prevenir comportamientos perjudiciales en la edad adulta.

Para el estudio del comportamiento estratégico, se han desarrollado investigaciones basadas en juegos económicos (Sher et al., 2014; Brocas y Carrillo, 2018), en los que se pide a los participantes que seleccionen una acción teniendo en cuenta las posibles decisiones de los demás. En este contexto, una mejor respuesta es la acción que maximiza el pago del individuo dadas sus creencias sobre las acciones de los otros jugadores. Un *equilibrio de Nash* se alcanza cuando cada jugador elige una estrategia que constituye una mejor respuesta a las estrategias elegidas por los demás (Holt y Roth, 2004). Por tanto, jugar de acuerdo con un equilibrio requiere anticipar el comportamiento de los demás y responder de manera óptima a ese comportamiento esperado, lo que puede implicar cierto nivel de capacidad cognitiva.

Para razonar estratégicamente y jugar en equilibrio, según Brocas y Carrillo (2025), los individuos deben desarrollar tres capacidades fundamentales. En primer lugar, la *Theory of Mind (ToM)*, entendida como la capacidad de atribuir creencias, intenciones y comportamientos a los demás. En segundo lugar, el *razonamiento lógico abstracto*, que se refiere específicamente a la capacidad de pensamiento hipotético y contrafactual, necesaria para evaluar cursos de acción alternativos en un contexto estratégico. Por último, las *creencias recíprocas*, que implican compartir creencias mutuas sobre las intenciones del otro jugador con el objetivo de coordinarse en un equilibrio específico, y que los autores describen como una forma de ToM de orden superior.

Aunque estudios recientes sugieren que los sujetos no son capaces de elaborar estrategias antes de, al menos, los 7 años de edad, varios trabajos han encontrado una relación positiva entre razonamiento estratégico y habilidades cognitivas en población no adulta (Sher et al., 2014; Blake et al., 2015; Brocas y Carrillo, 2018; Brocas et al., 2017), así como en población adulta (Brañas-Garza et al., 2012; Gill y Prowse, 2016). Con el desarrollo de la *ToM*, los niños se vuelven gradualmente capaces de reconocer las implicaciones estratégicas, lo que se desarrolla a lo largo de la educación primaria (Perner, 1991; Wellman et al., 2001). Los niños también deben utilizar información sobre los demás para determinar la mejor respuesta y

deben apoyarse en el pensamiento contrafactual para evaluarla, lo cual se desarrolla durante la educación secundaria (Piaget, 1972; Rafetseder et al., 2013; De Neys y Everaerts, 2008). Así, el razonamiento en juegos económicos parece desarrollarse, de esta forma, a los 10 años y estabilizarse en la población adolescente (Brosig-Koch et al., 2015; Brocas y Carrillo, 2021; Czermak et al., 2016). Por lo tanto, se espera que el desarrollo de las habilidades cognitivas favorezca el razonamiento estratégico. Esto indica que, a medida que crecemos, adquirimos gradualmente habilidades cognitivas que se transfieren a nuestra capacidad para encontrar estrategias óptimas. En consecuencia, cabría esperar que el rendimiento en juegos estratégicos mejore con la edad.

No obstante, la relación entre la edad y la capacidad para seleccionar estrategias eficientes ha recibido una atención limitada (Glätzle-Rützler et al., 2025). Y comprender cómo se desarrolla la eficiencia estratégica durante estos años es fundamental, dados los desafíos que necesitan de la capacidad de anticiparse a los demás en la adolescencia (por ejemplo, decidir en qué plataformas de redes sociales participar, escoger una carrera universitaria, saber y ser conscientes de primera mano si están sufriendo acoso escolar, etc.).

Pero todavía existe una comprensión limitada sobre cuándo los seres humanos adquieren la capacidad de pensar estratégicamente y cómo evoluciona el uso de estrategias efectivas en la población adolescente (Cooper y Weber, 2020). Sigue siendo una cuestión sin resolver si los niños y adolescentes son capaces de emplear estrategias eficientes y si esta capacidad se desarrolla con la edad. El estudio realizado por Glätzle-Rützler et al. (2025) no encontró evidencia de que la edad influyera en la sofisticación estratégica. Sin embargo, esto contrasta con los hallazgos de Brocas y Carrillo (2025), donde sus resultados indicaron que los participantes de mayor edad tenían más probabilidades de converger hacia resultados óptimos.

La presente tesis busca esclarecer y arrojar luz sobre *cómo las habilidades cognitivas y la edad influyen en la toma de decisiones estratégicas* en la población adolescente. La gran mayoría de los participantes de los experimentos de esta in-

vestigación son alumnos y alumnas de escuelas de educación secundaria de España, mientras que otra parte son estudiantes universitarios. Los datos de esta investigación provienen de proyectos liderados por *Loyola Behavioral Lab*, gestionados dentro del *TeensLab*, un consorcio formado por diferentes universidades españolas. La mayoría de los datos de esta investigación fueron recogidos por el mismo autor de esta tesis, que desempeñó el rol de *Coordinador de campo* en todos los experimentos del proyecto del que esta investigación forma parte.

La tesis se estructura en tres partes: I Metodología, II Artículos derivados de la tesis y III Conclusiones generales. La primera parte expone las metodologías empleadas durante la investigación, concretamente los enfoques *lab-in-the-field* y de *laboratorio*, describiendo el proceso de recolección de datos, los elementos incorporados al diseño experimental, las tareas realizadas por los participantes y las muestras utilizadas en el análisis empírico de los capítulos 3, 4 y 5.

La segunda parte expone el análisis de los datos obtenidos. El Capítulo 3 examina en qué medida la edad y las habilidades cognitivas predicen el pensamiento estratégico en adolescentes en juegos de coordinación. El Capítulo 4 analiza el efecto de distintos sistemas de incentivos sobre el pensamiento estratégico en adolescentes. Por último, el Capítulo 5 examina en qué medida las habilidades cognitivas predicen el pensamiento estratégico en dos diseños experimentales adicionales.

Finalmente, la tercera parte expone las conclusiones generales de la tesis, donde se muestran los principales hallazgos y se comentan posibles futuras líneas de investigación.

1.1 Objetivos

La Parte II de la presente tesis se estructura en tres objetivos generales, distribuidos en los capítulos 3, 4 y 5, que se detallan a continuación.

Por un lado, el objetivo general del Capítulo 3 es ”*Analizar cómo la edad y la capacidad cognitiva se relacionan con el uso deliberado de distintos principios de*

coordinación estratégica en juegos en la población adolescente". Para lograr este objetivo general, se propusieron los siguientes objetivos específicos:

$OE1_1$: Analizar el efecto de la edad y la capacidad cognitiva en la coordinación en el equilibrio de Nash en la población adolescente.

$OE1_2$: Comparar si los principios de coordinación basados en pago y riesgo presentan trayectorias diferentes en la población adolescente.

Para cumplir los objetivos mencionados del Capítulo 3, se dispuso de una muestra de 2.131 participantes que abarca la infancia tardía, la adolescencia y la adultez temprana en España, recopilada a través de dos submuestras complementarias: un experimento lab-in-the-field realizado en 20 centros de educación secundaria (Estudio 1, n = 1.716) y un experimento de laboratorio en la Universidad Loyola Andalucía con visitantes de bachillerato y estudiantes universitarios (Estudio 2, n = 415).

Se analizaron dos principios de coordinación estratégica mediante un juego de coordinación con equilibrio dominante en pagos y otro con equilibrio dominante en riesgo, utilizando un diseño adaptado y comprensible para las distintas edades analizadas. Los participantes debían pulsar un botón para coordinarse con otro jugador en dos juegos adaptados del *Stag-Hunt* de una sola ronda. Además de la acción realizada, se recogió la razón por la cual los participantes seleccionaron su respuesta, lo que permitió distinguir entre elecciones consistentes con el equilibrio y elecciones basadas deliberadamente en principios de coordinación estratégica.

Los principales resultados muestran una marcada asimetría en los patrones asociados a la edad entre ambos principios de coordinación. La coordinación en el equilibrio que es dominante en pagos ya es prevalente en las edades más tempranas estudiadas y se mantiene estable a lo largo de las distintas edades analizadas, sin un efecto significativo de la edad y con trayectorias similares entre grupos de capacidad cognitiva y de género. En contraste, la coordinación en el equilibrio de Nash que minimiza el riesgo emerge gradualmente y aumenta de forma sostenida con la edad, con un gradiente altamente heterogéneo: se concentra en los individuos de mayor

capacidad cognitiva y presenta una trayectoria más pronunciada entre los hombres, mientras que los individuos de baja capacidad cognitiva y las mujeres muestran trayectorias considerablemente más planas. Estos resultados permiten conciliar hallazgos previos aparentemente contradictorios en la literatura: se sitúan en línea con los encontrados por Glätzle-Rützler et al. (2025), que no observan efecto de la edad en juegos estratégicos de una sola ronda cuando se considera la coordinación basada en pagos; y, al mismo tiempo, son consistentes con el patrón documentado por Brocas y Carrillo (2025), que apunta a una mayor coordinación basada en riesgo con la edad en niños y adolescentes.

El Capítulo 4 tiene como objetivo general "*Analizar si existen diferencias en el efecto de los incentivos monetarios respecto a los hipotéticos en la medición del comportamiento estratégico en juegos de coordinación*". Posee a su vez los siguientes objetivos específicos:

$OE2_1$: Analizar si los incentivos monetarios generan diferencias respecto a los hipotéticos en las decisiones de coordinación en el equilibrio de Nash.

$OE2_2$: Analizar el efecto del orden de presentación de los juegos de coordinación en las decisiones estratégicas.

Para lograr los objetivos mencionados anteriormente, se utilizaron dos muestras, compuestas por 242 y 301 participantes, respectivamente. Los datos fueron recogidos mediante dos experimentos de laboratorio realizados en la Universidad Loyola Andalucía. Los participantes correspondían a estudiantes de bachillerato que visitaban la universidad durante jornadas de puertas abiertas y a estudiantes universitarios de dicha institución, localizados en las provincias de Córdoba y Sevilla (España).

Se analizaron tanto las decisiones como las justificaciones de respuesta asociadas en los juegos de coordinación diseñados en el capítulo anterior, comparando esquemas de incentivos monetarios e hipotéticos. Los resultados muestran que: *i*) no se observan diferencias ni en las decisiones de coordinación ni en los argumentos utilizados para justificarlas según el tipo de incentivo empleado, y *ii*) tampoco se

encuentran efectos derivados del orden de presentación de los juegos. Los resultados obtenidos en este capítulo son consistentes con investigaciones previas que no encuentran diferencias relevantes entre incentivos reales e hipotéticos en experimentos económicos (Brañas-Garza et al., 2021; Brañas-Garza et al., 2023). En conjunto, estos hallazgos sugieren que los incentivos hipotéticos pueden constituir una herramienta válida para el estudio del comportamiento estratégico en juegos de coordinación.

Finalmente, el Capítulo 5 tiene como objetivo "*Analizar el efecto de las habilidades cognitivas en el comportamiento estratégico en juegos estáticos y dinámicos adaptados a la población adolescente*". Además, se encuentra el siguiente objetivo específico:

$OE3_1$: Analizar si las habilidades cognitivas predicen el comportamiento estratégico en juegos estáticos y dinámicos y examinar el efecto de la edad para la población adolescente.

Para poder cumplir con el objetivo del Capítulo 5, se dispuso de una muestra adicional de estudiantes de educación secundaria de la región de Andalucía (España). Cada sujeto completó uno de los siguientes dos diseños experimentales, adaptados a una versión de una ronda de dos jugadores: un juego de cartas basado en el "*Beauty Contest*" de Nagel (1995) (N = 2.718), y un juego dinámico de acumulación con horizonte temporal cuyo origen se encuentra en el "*Chicken Game*" (Rapoport y Chammah, 1966) y en el marco de la "*War of Attrition*" (Smith, 1974; Fudenberg y Tirole, 1991) (N = 653).

Como mediciones adicionales de la investigación en este quinto capítulo, no solamente se construyeron variables dicotómicas para analizar cuándo se juagaba el *equilibrio de Nash*, sino que, también, se construyeron variables que analizaban la desviación del equilibrio ("*Trembling*") y la distancia respecto al equilibrio ("*Rationality*"). Los principales resultados hallados en este capítulo permiten esclarecer que, de nuevo, las habilidades cognitivas son un factor determinante de la capacidad

de pensar estratégicamente, esta vez en juegos competitivos, en lugar de juegos de coordinación como se ha comentado en los Capítulos 3 y 4. Además, se encuentra que los individuos tienden a jugar la mejor respuesta de forma más frecuente en el *Beauty Contest* que en el segundo juego, a pesar de que la relación entre las habilidades cognitivas y la capacidad de pensar estratégicamente es más significativa en el juego dinámico de acumulación. Por último, en esta tercera investigación, no se ha hallado efecto significativo de la edad de los sujetos respecto a las variables dependientes analizadas, en consonancia con la estabilidad observada para la coordinación basada en pagos en el Capítulo 3.

Para la determinación de las habilidades cognitivas, se diseñó una variable adicional ("*CogAb*") conformada por tres tareas adicionales: un test de reflexión cognitiva[1] ("*Cognitive Reflection Test*", *CRT*), una prueba de tres preguntas sobre alfabetización financiera y numérica[2], y tres ítems adicionales sobre razonamiento probabilístico[3]. Cada una de las tres tareas mencionadas tenía una puntuación total entre 0 y 3, donde se sumaban las diferentes respuestas reflexivas del *CRT*, las respuestas correctas de la prueba sobre finanzas y matemáticas, y cada aplicación correcta de los tres ítems sobre leyes de probabilidad.

Los resultados se encuentran en línea con lo hallado previamente en otras investigaciones. Los individuos con puntuaciones más altas en pruebas de capacidad cognitiva tienen mayor probabilidad de jugar estrategias dominantes, tanto en juegos basados en el *Beauty Contest* (Ballester et al., 2024; Gill y Prowse, 2016; Brañas-Garza et al., 2012; Burnham et al., 2009) como en juegos dinámicos que requieren razonamiento secuencial e inducción hacia atrás (Carpenter et al., 2013; Brosig-Koch et al., 2015). En relación con la edad como factor explicativo de la capacidad de pensar estratégicamente, los resultados se asemejan más a los hallazgos de investigaciones como las de Glätzle-Rützler et al. (2025) y Hermes y Schunk (2022), donde tampoco se observan efectos significativos de la edad en juegos estratégicos

[1] Introducido por Frederick (2005) y adaptado por Thomson y Oppenheimer (2016).
[2] Introducida por Alfonso et al. (2025).
[3] Adaptados de Delavande y Rohwedder (2008).

de una sola ronda en niños y adolescentes, que a los de Brocas y Carrillo (2025), basados en interacción repetida.

1.2 Conclusiones

La presente tesis analiza la relación entre las habilidades cognitivas y el comportamiento estratégico en niños y adolescentes. Para ello, se desarrollan tres líneas de investigación correspondientes a los Capítulos 3, 4 y 5. Cada capítulo utiliza muestras y diseños experimentales específicos, lo que permite analizar la robustez de los resultados obtenidos en distintos entornos estratégicos y metodológicos.

El primer objetivo explora la posible relación entre la edad y su evolución de la población adolescente en la capacidad de pensar estratégicamente.

Por otro lado, ya que se usaron incentivos hipotéticos para la comprobación del primer objetivo, como segundo objetivo se corrobora que este procedimiento no ha traído efectos adversos en la extracción de conclusiones.

El tercer objetivo introduce nuevos diseños experimentales para analizar la relación entre habilidades cognitivas y comportamiento estratégico, evaluando además la robustez de los patrones observados en los capítulos anteriores.

La presente tesis se estructura en tres partes. La primera describe la metodología empleada, incluyendo la obtención de los datos, las características de las distintas muestras y los diseños experimentales utilizados. La segunda parte presenta los capítulos empíricos, donde se analizan distintos aspectos del comportamiento estratégico en niños y adolescentes. Finalmente, la tercera parte recoge las conclusiones generales de la investigación y plantea posibles líneas futuras de estudio.

La principal contribución de esta investigación es aportar nueva evidencia sobre la relación entre las habilidades cognitivas y el comportamiento estratégico en la población adolescente. En concreto, se contribuye a la creciente literatura sobre investigación experimental con niños y adolescentes al avanzar en la comprensión metodológica y conductual del razonamiento estratégico durante esta etapa crítica

del desarrollo (Brocas y Carrillo, 2020a; Sutter et al., 2019).

Los resultados sugieren que el comportamiento estratégico en la adolescencia se encuentra más estrechamente relacionado con las habilidades cognitivas y la reflexión cognitiva que con la edad en sí misma o la maduración física, ofreciendo nuevas perspectivas sobre cómo el razonamiento y la anticipación se desarrollan en paralelo a las capacidades cognitivas.

Asimismo, la tesis muestra que el diseño de herramientas experimentales adecuadas resulta esencial no solo para observar el comportamiento, sino también para identificar los procesos cognitivos que lo sustentan. En esta línea, los resultados también sugieren que el uso de incentivos hipotéticos no altera de forma significativa las decisiones estratégicas ni el razonamiento asociado en este tipo de entornos experimentales. Este hallazgo es especialmente relevante desde el punto de vista metodológico, ya que facilita la implementación de experimentos con muestras amplias de niños y adolescentes en contextos escolares, donde el uso de incentivos monetarios reales suele presentar mayores restricciones logísticas, éticas y administrativas.

Como en otras investigaciones previas, se enfatizan las diferencias individuales (Morra et al., 2012), sugiriendo que las habilidades de pensamiento estratégico se encuentran presentes antes de lo que se pensaba previamente (Goswami, 2010). Interpretamos este resultado como consistente con estudios que muestran una relación entre cognición y desempeño en juegos económicos (Brañas-Garza et al., 2012; Gill y Prowse, 2016; Proto et al., 2020; Fe et al., 2022).

No obstante, esta investigación no solamente contribuye a reforzar la literatura existente, sino que también proporciona información valiosa para la sociedad en materia de prosperidad y prevención. Estudiar el desarrollo del pensamiento estratégico es clave para comprender determinadas tomas de decisiones perjudiciales en contextos sociales. Las decisiones que toman niños, adolescentes y adultos requieren la anticipación de resultados futuros y el llamado *razonamiento de inducción hacia*

atrás. Precisamente, la población adolescente se encuentra especialmente expuesta a situaciones donde la anticipación de eventos y de las intenciones de otras personas resulta fundamental para evitar decisiones erróneas que podrían tener consecuencias difíciles de revertir en el futuro. Ejemplos de ello incluyen la participación en actividades de riesgo (como la conducción de vehículos a motor a edades tempranas), la aceptación del consumo de drogas o el mantenimiento de relaciones sexuales sin protección. Tomar decisiones adecuadas en estos entornos requiere comprender las intenciones de los demás y anticipar sus posibles consecuencias. Los fallos en estas capacidades se encuentran estrechamente vinculados con habilidades lógicas y cognitivas insuficientemente desarrolladas, por lo que planteamos que el nivel de sofisticación estratégica detectado mediante juegos experimentales sencillos podría estar relacionado con el comportamiento de los individuos en determinados contextos sociales.

El fin último de esta investigación es la aportación de esta información para el lanzamiento de programas preventivos y de intervención. Estos programas podrían orientarse al entrenamiento cognitivo y el desarrollo a largo plazo de las habilidades estratégicas que contribuyan a mejorar la capacidad estratégica y anticipatoria de los individuos. Dichas intervenciones han mostrado efectos prometedores sobre distintos resultados cognitivos en jóvenes (Shepard et al., 2023; Birtwistle et al., 2025; Traverso et al., 2015; Paananen et al., 2022) en las llamadas "*funciones ejecutivas*", como son la memoria de trabajo; el control inhibitorio; la flexibilidad cognitiva; o la planificación y el control atencional, y que son maleables y medibles, prediciendo éxito académico, adaptación social y salud mental (Wenzel y Gunnar, 2013; Duncan et al., 2024). El desarrollo exitoso de programas dirigidos a mejorar la lógica inductiva y las habilidades cognitivas en población infantil y adolescente podría generar importantes beneficios sociales, favoreciendo mejores resultados académicos y personales, reduciendo desigualdades educativas (Korpa et al., 2020; Diamond y Lee, 2011) y mejorando distintos aspectos emocionales y conductuales (Wenzel y Gunnar, 2013; Romero-López et al., 2021).

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Part I

METHODOLOGY

Chapter 2

Methodology

In this chapter, we describe the methodology employed in the research. Different samples were used for the development of the chapters. These samples shared the same general procedures, although there were differences in the tasks completed by the participants.

Two complementary methodologies were used throughout this thesis: **lab-in-the-field experiments**, conducted in primary and secondary schools, and **laboratory experiments**, conducted at Universidad Loyola Andalucía. It is important to note that this distinction does not map one-to-one with chapters: while Chapter 5 relies exclusively on lab-in-the-field data and Chapter 4 on laboratory data, Chapter 3 combines both methodologies, drawing on a lab-in-the-field experiment (Study 1) and a complementary laboratory experiment (Study 2). The relationship between methodology, chapters and studies is summarized as follows:

- **Chapter 3**: lab-in-the-field experiment in secondary schools (Study 1) plus laboratory experiment at Universidad Loyola Andalucía (Study 2).
- **Chapter 4**: laboratory experiments only, conducted at Universidad Loyola Andalucía.
- **Chapter 5**: lab-in-the-field experiments only, conducted in secondary schools.

In both methodologies, we followed recommendations for designing experiments aimed at children and adolescents, using simplified designs to accommodate participants' limited attention and presenting tasks in a dynamic and visual way (Brocas and Carrillo, 2020). As part of the procedure, before starting, participants received a briefing explaining that they would take part in a research study, and the facilitator or research assistants informed them that their data would be anonymous and that they only needed to read the screens to understand each game they would encounter throughout the software.

The experiments also included additional experimental tasks to measure different aspects of participants' decision-making. However, we did not use all tasks in this thesis, and those that were used have been described in detail in each chapter. Therefore, the additional tasks used in each type of experiment are briefly described below to avoid repetition. It is important to note that each task includes its own set of instructions.

The remainder of this chapter is organized as follows. First, the lab-in-the-field methodology is described, covering its application in Chapter 3 and in Chapter 5. Second, the laboratory methodology is described, covering its application in Chapter 3 and in Chapter 4. Finally, the characteristics and descriptive statistics of the sample used in each chapter are presented.

2.1 Lab-in-the-field: Experiments in schools

2.1.1 Procedures

For the data collection in Study 1 of Chapter 3 and in Chapter 5, we ran lab-in-the-field experiments. These data are part of a project that studies how adolescents make decisions (Vasco et al., 2025).

This research is part of a project coordinated by the Loyola Behavioral Lab (LoyolaBehLab) within TeensLab, a consortium of universities mainly from different regions of Spain[1]. These lab-in-the-field experiments are part of a dataset that in-

[1] Visit: `https://loyolabehlab.org/teenslab/` for more details.

cludes 33 schools, covering different levels of primary education, secondary education, high school, and various intermediate and advanced vocational training programs, totaling more than 5,000 observations from ages 10 to 20. Specifically, the lab-in-the-field component used in this thesis combines data from 20 schools for Study 1 of Chapter 3 and 13 additional schools for Chapter 5, with no overlap between the two sets of schools. The dataset was published by Vasco et al. (2025). While the study was approved by the Ethics Committee of Loyola Andalucía University, for primary education students in the dataset, approval was granted by the Bioethics Commission of the University of Barcelona.

The experiment was integrated into the academic curriculum, where students completed the questionnaire during class time, usually during a weekly session with their tutor (see Figure 2.1). The entire experiment in each class never lasted more than 50 minutes. Importantly, there were no opt-outs, eliminating any possible selection bias. Students always completed the experiment under adult supervision, typically by teachers, research assistants, or a facilitator collaborating in the data collection, as well as the field coordinator (the author of this thesis).

Figure 2.1: Experiment session in a secondary education school in Andalucia (2021)

Data was collected primarily using tablets in classrooms. In addition, students an-

swered using their own mobile phones or school computers when tablets were not available.

The procedure was as follows: teachers, research assistants or the field coordinator arrived in the classroom with a set of tablets, distributed one to each student, and each student logged in using a username and password associated with their identity. Upon entering the software application, an initial screen of the experiment appeared (see Figure 2.2), where participants had to provide consent for their data to be processed (despite the survey being anonymous and using codes associated with their names).

Lab-in-the-field experiments were programmed on a platform that ensures control over data privacy: SAND[2]. This platform was developed by Kampal company under the specifications and requirements of TeensLab, whose main objective was to obtain a platform that ensured data privacy while allowing potential non-anonymous interaction within the experiments.

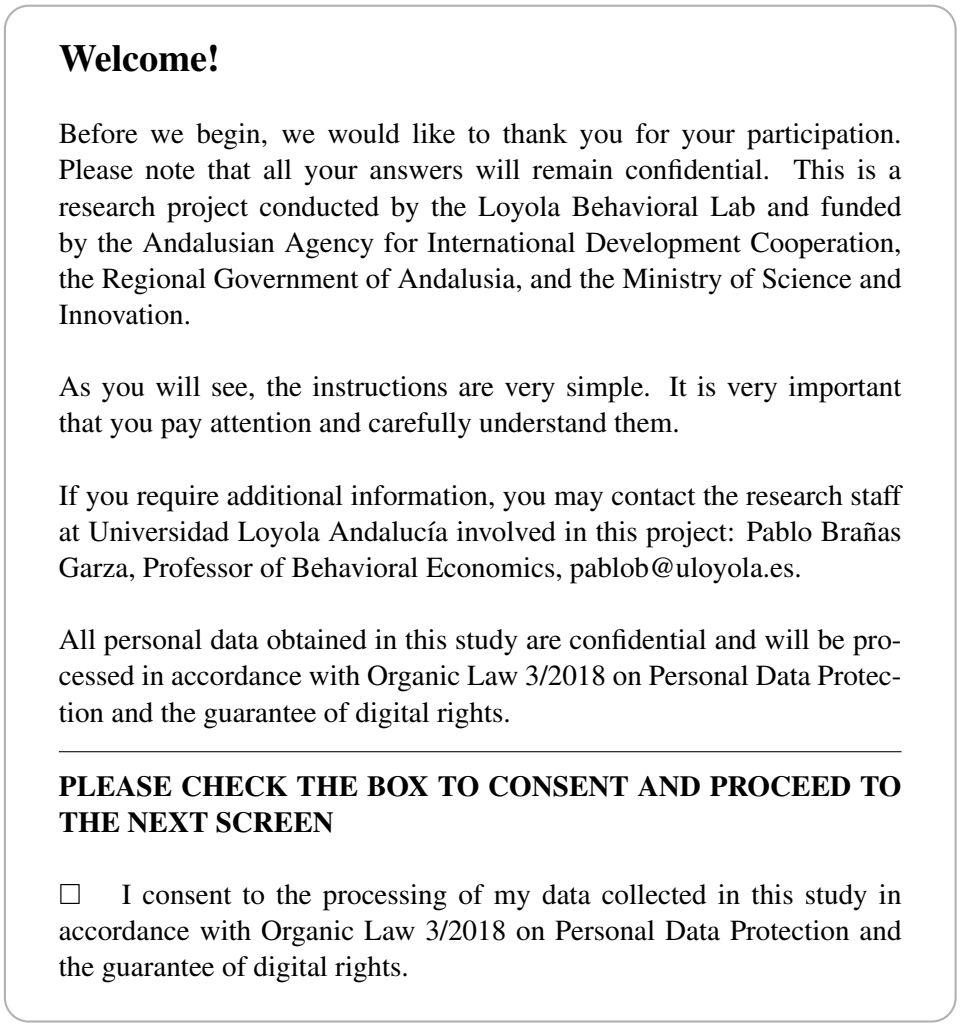
Participants completed the questionnaires individually and without receiving monetary incentives, making the decisions purely hypothetical. It has already been shown that the non-adult population does not change its behavior in economic experiments in the absence of monetary incentives (Brañas-Garza et al., 2021; Alfonso et al., 2023; Brañas-Garza et al., 2023). However, despite this evidence, in order to extend the developmental sample of Chapter 3 into early adulthood and to test directly whether coordination games show any effect from the use of different incentive schemes (Chapter 4), we additionally implemented complementary laboratory sessions. These laboratory sessions, which constitute Study 2 of Chapter 3 and the entirety of Chapter 4, are described in the following section.

2.1.2 Games

For Study 1 of Chapter 3 and for Chapter 5, we developed four economic games based on Game Theory. We used two coordination games in Chapter 3, while two

[2]Acronym for Social Analysis and Network Data. Platform offered by Kampal company (https://www.kampal.com/)

Figure 2.2: Initial screen of lab-in-the-field experiment



Welcome!

Before we begin, we would like to thank you for your participation. Please note that all your answers will remain confidential. This is a research project conducted by the Loyola Behavioral Lab and funded by the Andalusian Agency for International Development Cooperation, the Regional Government of Andalusia, and the Ministry of Science and Innovation.

As you will see, the instructions are very simple. It is very important that you pay attention and carefully understand them.

If you require additional information, you may contact the research staff at Universidad Loyola Andalucía involved in this project: Pablo Brañas Garza, Professor of Behavioral Economics, pablob@uloyola.es.

All personal data obtained in this study are confidential and will be processed in accordance with Organic Law 3/2018 on Personal Data Protection and the guarantee of digital rights.

PLEASE CHECK THE BOX TO CONSENT AND PROCEED TO THE NEXT SCREEN

☐ I consent to the processing of my data collected in this study in accordance with Organic Law 3/2018 on Personal Data Protection and the guarantee of digital rights.

competitive strategy games were implemented in Chapter 5. All these four games were simultaneous and consisted of one-shot, two-player versions in which participants had perfect and symmetric information.

For Chapter 3, we designed two Stag-Hunt coordination games[3]. One of these games was payoff-dominance (*PayD*) solvable, while the other was risk-dominance (*RiskD*) solvable. In these games, participants had to choose one of two buttons, with payoffs depending on both their own choice and that of their counterpart. Importantly, in addition to recording the button selected, we also incorporated for each

[3]This game dates back further than is often assumed, as Rousseau (1999) already referred to it in the eighteenth century.

game a closed list of four options from which participants were required to choose the reasoning or justification underlying their decision. These options provided crucial information that allowed us to refine the instrument and to more precisely identify participants who were coordinating according to a principle of rationality, rather than responding randomly. For details regarding the interface and experimental design presented to participants, see the appendices of Chapters 3 and 4.

For Chapter 5, we developed two competitive experimental games. First (*CARDS*), an adapted version of the Beauty Contest Game (*BCG*) (Nagel, 1995) based on a card game. Second (*PIGGY*), a dynamic accumulation game grounded in the Chicken Game (Rapoport and Chammah, 1966) and the War of Attrition framework (Smith, 1974; Fudenberg and Tirole, 1991). In contrast to the games used in Chapters 3 and 4, in these two games participants competed to obtain the highest individual payoff, rather than attempting to maximize joint rewards. In *CARDS*, participants had to choose the card number that maximized their payoff while ensuring that their opponent could not interrupt or modify their decision. In *PIGGY*, participants had to press a button to stop the accumulation in a virtual piggy bank within a 30-second time limit: pressing after their opponent allowed them to claim the accumulated amount, while pressing first yielded zero. For more details about the game interfaces, see the Appendix in Chapter 5.

2.1.3 Additional tasks

In addition to the different games completed by the participants, additional tasks were administered for the lab-in-the-field components of Chapters 3 and 5. Specifically, a set of cognitive ability tests was used to construct a composite cognitive ability index, which is described in detail in both aforementioned chapters. Furthermore, in Chapter 5, risk and time preferences were also elicited.

Regarding cognitive abilities, the measure was constructed as the sum of three cognitive tests, each consisting of three questions: a Cognitive Reflection Test (CRT)[4],

[4]Developed by Frederick (2005) and adapted by Thomson and Oppenheimer (2016).

a financial literacy test[5], and three probabilistic reasoning items[6]. The specific questions can be found in the Appendices of Chapters 3 and 5.

With respect to preference elicitation, in Chapter 5, time preferences were measured using the "*Truck Task*"[7], while risk preferences were measured using the "*Gumball Machine Task*"[8].

2.2 Laboratory experiments

2.2.1 Procedures

The laboratory component of this thesis comprises Study 2 of Chapter 3 and Chapter 4. All laboratory sessions were conducted at Universidad Loyola Andalucía and shared a common protocol, with two complementary objectives: in Chapter 3, the laboratory sample (Study 2) extends the lab-in-the-field developmental sample (Study 1) into early adulthood; in Chapter 4, the laboratory environment is exploited to test the role of incentive schemes and game order under controlled conditions.

For Chapter 4, we ran two studies. While the first study consisted of undergraduate students and high school students who visited the university during open-day events, the second study included a sample composed entirely of university students. In the first study, we only examined the use of different incentive schemes, whereas in the second study we implemented a 2×2 randomization to test, in addition to the use of different incentive models, the reversed order of the games presented in Chapters 3 and 4. Randomization was carried out at the individual level.

The experiments were designed in Qualtrics and conducted in classrooms, where participants read the instructions and all responded using their mobile phones. Either the field coordinator or the class instructor was present. A presentation was projected explaining that participants would take part in a research study, after which

[5] Developed by Alfonso et al. (2025).

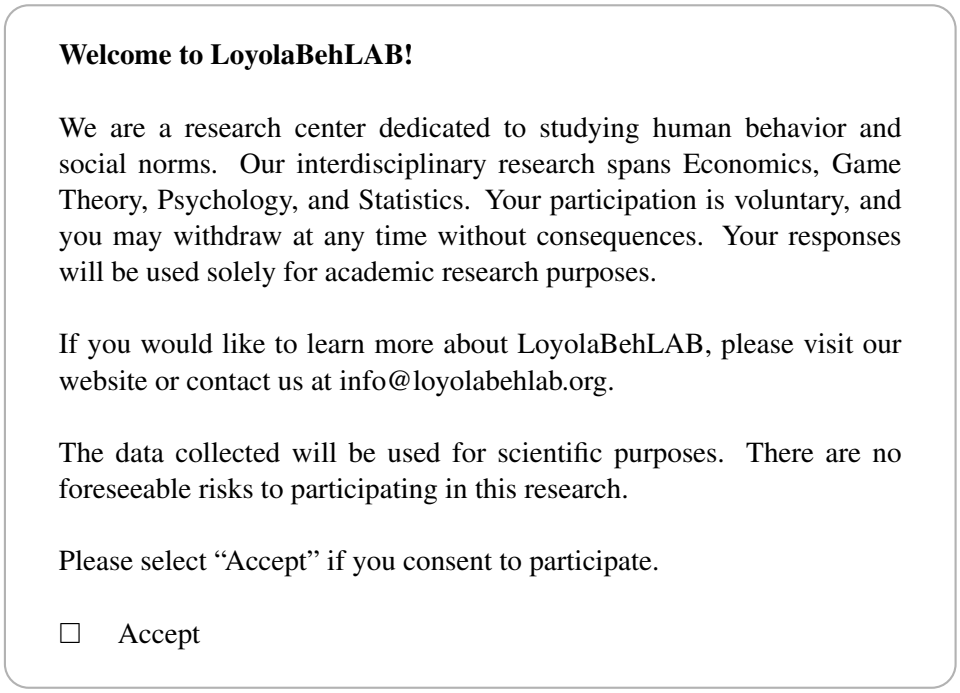
[6] Adapted from Delavande and Rohwedder (2008).

[7] A visual version of the Multiple Price List task of Coller and Williams (1999), introduced by Alfonso et al. (2023).

[8] A graphical version of the Holt and Laury (2002) risk preference elicitation test, introduced by Vasco and De Francisco (2023).

they scanned a QR code that directed them to the Qualtrics page displaying the first screen of the experiment (see Figure 2.3), where they had to consent to the processing of their data (fully anonymous) in order to begin answering.

Figure 2.3: Initial screen of laboratory experiment


Welcome to LoyolaBehLAB!

We are a research center dedicated to studying human behavior and social norms. Our interdisciplinary research spans Economics, Game Theory, Psychology, and Statistics. Your participation is voluntary, and you may withdraw at any time without consequences. Your responses will be used solely for academic research purposes.

If you would like to learn more about LoyolaBehLAB, please visit our website or contact us at info@loyolabehlab.org.

The data collected will be used for scientific purposes. There are no foreseeable risks to participating in this research.

Please select "Accept" if you consent to participate.

☐ Accept

2.2.2 Games

The games used in Study 2 of Chapter 3 and in the two studies of Chapter 4, all of which were part of the laboratory experiments, followed the same design as the coordination games implemented in Study 1 of Chapter 3. That is, the same two coordination games (one payoff-dominant and one risk-dominant) were used. The differences across studies relate exclusively to the incentive scheme and, in Chapter 4, to the introduction of randomization in the order in which the games were presented.

In the first study of Chapter 4, we introduced a 50% probability that participants would be paid according to the outcomes obtained in the coordination games. In the second study, we implemented a 2×2 randomized design in which, in addition to randomizing monetary versus hypothetical payments for performance in the co-

ordination games, we also reversed the order in which participants responded to the games (*PayD* followed by *RiskD*, or alternatively *RiskD* followed by *PayD*).

2.2.3 Additional tasks

In addition to the games subjects played in the laboratory experiments of Chapter 4, participants answered two additional tasks: an affective Theory of Mind (*ToM*) task[9], and a Cognitive Reflection Test (*CRT*)[10]. Only the ToM task was incentivized for one randomized group, while the other group obtained a monetary reward for their performance in the coordination games. These additional tasks are detailed in the corresponding appendices of the chapter.

2.3 Sample

This thesis uses a set of samples that combine, as previously explained, two types of experiments: lab-in-the-field and laboratory experiments. As described, participants include various educational levels, from primary education to university. The data come from different regions of Spain, mainly from provinces in Andalusia and Catalonia. In total, this thesis draws on data from 33 secondary schools and from laboratory sessions conducted at Universidad Loyola Andalucía.

Separating by type of experiment, the **lab-in-the-field** samples include participants aged 10 to 17 enrolled in primary or secondary education institutions, together with a small pilot of undergraduate students from Universidad Loyola Andalucía that was incorporated into Study 1 of Chapter 3. These lab-in-the-field experiments were carried out across 33 schools in total, distributed between the data collection efforts used in Study 1 of Chapter 3 (20 schools) and Chapter 5 (13 schools).

In contrast, the **laboratory experiment** samples include participants from Universidad Loyola Andalucía, as well as high school students who visited this university

[9]The *ToM* task was measured using the *Developmental Read the Mind in the Eyes Test* designed by Alfonso Costillo et al. (2023). The task consists of 10 images of a child's eyes expressing different emotions, each accompanied by four possible answers, one of which best represents the depicted emotion.

[10]The CRT follows the task introduced by Frederick (2005) and adapted by Thomson and Oppenheimer (2016).

during orientation events designed to help them explore different degree programs before making their academic choices. These laboratory data were used to complement the lab-in-the-field sample in Chapter 3 (Study 2) and to constitute the main source of evidence for Chapter 4.

Following the general description of the sample provided above, the statistics, composition, and distribution of the different sub-samples for each chapter are discussed within each respective chapter. Nevertheless, this section briefly describes the self-reported variables of *female*, *age*, and the distribution across *academic grades*.

First, in Chapter 3, a total of 2,131 observations were obtained by combining a lab-in-the-field experiment conducted in 20 secondary schools (Study 1, n = 1,716) and laboratory sessions held at Universidad Loyola Andalucía (Study 2, n = 415). The descriptive statistics are presented in Table 2.1, where 48.3% of participants are female and the average age is 14.6 years old. The sample spans from late primary education to university, with the largest concentration in compulsory secondary education: 12.16% in 7th Grade, 14.03% in 8th Grade, 15.96% in 9th Grade, and 8.92% in 10th Grade. The complete statistics, including separate breakdowns for Study 1 and Study 2, are reported in Table 2.1.

Second, a laboratory experiment sample was used for Chapter 4. As previously mentioned, two sub-samples were obtained, consisting of 242 and 301 observations, respectively. The age range of participants is 17 to 28 years old, with 137 participants enrolled in the second year of high school and 406 at the university level. In the first sub-sample, 137 participants belong to high school education and 105 are undergraduate students, while the entire second sub-sample of 301 participants consists of university students. All participants in these two sub-samples belong to the Spanish region of Andalusia.

Table 2.2 reports the statistics. 48% of participants are female across the whole sample, the average age is 19 years, and a total of 25% belong to the second year of high school, while 75% are university students. The complete statistics for this

Table 2.1: Sample in Chapter 3

Variables	n	Mean	Min.	Max.
All sample in Chapter 3				
Female	2,131	0.48	0	1
Age	2,131	14.60	10	20
Distribution across grades:				
5^{th} grade	173	8.12%		
6^{th} grade	213	10.00%		
7^{th} grade	259	12.16%		
8^{th} grade	299	14.03%		
9^{th} grade	340	15.96%		
10^{th} grade	190	8.92%		
11^{th} grade	73	3.43%		
12^{th} grade	119	5.59%		
Vocational Training	111	5.21%		
University	354	16.61%		
Total	2,131	100.00%		
Study 1				
Female	1,716	0.487	0	1
Age	1,716	13.67	10	20
Distribution across grades:				
5^{th} grade	173	10.08%		
6^{th} grade	213	12.41%		
7^{th} grade	259	15.09%		
8^{th} grade	299	17.42%		
9^{th} grade	340	19.81%		
10^{th} grade	190	11.07%		
11^{th} grade	73	4.25%		
Vocational Training	111	6.47%		
University	58	3.38%		
Total	1,716	100.00%		
Study 2				
Female	415	0.463	0	1
Age	415	18.41	17	20
Distribution across grades:				
12^{th} grade	119	28.67%		
University	296	71.33%		
Total	415	100.00%		

chapter are reported in Table 2.2.

Finally, in Chapter 5, there are a total of 3,371 observations, of which 2,718 participants completed one experimental design (*CARDS*) and 653 completed the second experimental design (*PIGGY*). The descriptive statistics are presented in Table 2.3, where 48% of participants are female and the mean age is 12 years old in the full sample. All students are from secondary schools in the Spanish region of Andalusia. A total of 13 schools are included, with the distribution across the four secondary education grades as follows: 29% in 7th Grade, 30% in 8th Grade, 20% in 9th

Table 2.2: Sample in Chapter 4

Variables	n	Mean	Min.	Max.
All sample in Chapter 4				
Female	543	0.48	0	1
Age	543	19.10	17	28
Distribution across grades:				
2nd High School	137	25.00%		
University	406	75.00%		
Total	543			
Study 1				
Female	242	0.57	0	1
Age	242	18.57	17	28
Distribution across grades:				
2nd High School	137	57.00%		
University	105	43.00%		
Total	242			
Study 2				
Female	301	0.42	0	1
Age	301	19.53	18	26
Distribution across grades:				
University	301	100.00%		
Total	301			

Grade, and 20% in 10th Grade.

If we split the sample by experimental design, in *CARDS* we find that 47% of participants are female and the mean age is 12 years. The distribution of participants in *CARDS* is more concentrated in the first two years of secondary education compared to the last two years (60% versus 40%, respectively, when comparing these two blocks).

By contrast, in *PIGGY* the distribution across grades is more evenly balanced, with approximately 25% of the sample in each secondary school grade. Here, females represent 49% of the sample and the mean age reaches 13 years. The complete participant statistics are reported in Table 2.3.

Table 2.3: Sample in Chapter 5

Variables	n	Mean	Min.	Max.
All sample				
Female	3371	0.48	0	1
Age	3371	12.83	10	17
Distribution across grades:				
7th Grade	971	29.00%		
8th Grade	1026	30.00%		
9th Grade	683	20.00%		
10th Grade	691	20.00%		
Total	3371			
CARDS				
Female	2718	0.47	0	1
Age	2718	12.78	10	17
Distribution across grades:				
7th Grade	816	30.00%		
8th Grade	846	31.00%		
9th Grade	527	19.00%		
10th Grade	529	19.00%		
Total	2718			
PIGGY				
Female	653	0.49	0	1
Age	653	13.04	11	16
Distribution across grades:				
7th Grade	155	24.00%		
8th Grade	180	28.00%		
9th Grade	156	24.00%		
10th Grade	162	25.00%		
Total	653			

2.4 Conclusions

This Chapter describes the methodology employed throughout the thesis, providing a brief overview of the economic games used, as well as the procedures and settings in which the experiments were conducted. In addition, the chapter discusses the additional tasks completed by participants.

A key methodological feature of this thesis is the deliberate combination of two complementary approaches: lab-in-the-field experiments in primary and secondary schools, which allow us to capture the developmental trajectory of strategic thinking in childhood and adolescence, and laboratory experiments at Universidad Loyola Andalucía, which extend the developmental window into early adulthood and provide controlled conditions to test the robustness of the results to incentive schemes

and game order. Importantly, Chapter 3 integrates both methodologies through the combination of Study 1 (lab-in-the-field) and Study 2 (laboratory), while Chapter 4 relies entirely on laboratory experiments and Chapter 5 entirely on lab-in-the-field experiments.

One of the most relevant features of the sample used in this thesis is that the economic games were designed with the aim of being suitable for a non-adult population, thereby providing valuable insights into adolescent behavior, preferences, and strategic thinking.

In summary, the combination of Chapters 3, 4, and 5 results in a sample of more than 5,000 observations of students from 33 educational institutions in Spain together with laboratory sessions at Universidad Loyola Andalucía. This sample includes four economic games based on Game Theory, which allow the performance of children and adolescents in strategic thinking to be examined in relation to cognitive variables and different incentive and order schemes.

Looking ahead, the results derived from these samples may contribute to the development of cognitive training interventions for children, as well as educational strategies aimed at reducing educational gaps in society.

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Chapter 6

Future research

In this final chapter, I will present possible extensions of the research with the aim of continuing the work beyond the scope of this thesis. The intention is to explore potential extensions of the experiments conducted, seeking correlations with variables that have not yet been examined, and to propose new research directions that may contribute to a deeper understanding of the development of strategic thinking in children and adolescents.

For this reason, I first discuss new data sources that may be available to the researcher for further analysis. I then outline potential modifications to the experimental designs previously implemented, with the aim of achieving a larger sample size or a more comprehensive study. Finally, building on the literature reviewed throughout the preceding chapters of this thesis, I compile a set of additional variables that could be incorporated into the analysis of strategic behaviour in adolescents.

6.1 New dataset to explore

We have an additional sample comprising more than 5,200 observations from subjects in El Salvador who completed the different tasks analyzed in this dissertation. Specifically, the dataset includes more than 700 observations from *CARDS*, more than 1,700 from the *PIGGY* (both analyzed in Chapter 5), and more than 2,600

observations from the *Stag-Hunt* coordination game examined in Chapters 3 and 4.

This sample was collected across a total of 12 secondary schools, encompassing 123 classes, during the years 2022 and 2023.

In particular, examining the differences between subjects in these age groups and conducting cross-country comparisons that account for cultural differences could constitute a promising avenue for future research.

As proposed by Birch et al. (2017), sociocultural contexts appear to influence the development of reasoning. For instance, children in the United States tend to understand that people have different desires earlier than children in China (Wellman et al., 2006). Similar differences have also been documented in comparisons between children from Australia and Iran (Shahaeian et al., 2011).

Conducting research that examines the origins of cultural differences in strategic sophistication represents a promising direction for future work.

Lastly, it would be of interest to extend the age range under study to younger students, potentially covering ages as early as six. This is particularly relevant given that subjects begin to know how to strategize around the age of seven years old (Brocas and Carrillo, 2018), and such an extension could help improve our understanding of how the ability to think strategically evolves in humans.

6.2 Testing new experimental designs

It would be worthwhile to design experiments that mix participants from different academic cohorts, as proposed by Brocas and Carrillo (2025). They advance two main arguments. First, such a design would help disentangle choices made in strategic games from beliefs about opponents' behaviour. Second, it would allow researchers to examine whether younger children behave in a more mature or strategic manner in the presence of older peers, or whether older children exploit their advantage when facing younger counterparts under the assumption that they are cognitively less capable.

Moreover, it would be worthwhile to investigate the role of strategic reasoning in shaping participants' beliefs about the actions of their counterparts, as the literature suggests that this ability develops from early childhood through adolescence (Valle et al., 2015).

It would also be valuable to extend the design from a one-shot setting to a multi-round structure, allowing subjects to play repetitions of the same game. Evidence from experimental economics shows that repetition not only fosters convergence towards equilibrium but also reveals systematic individual differences in learning rates that are tightly linked to cognitive ability (Gill and Prowse, 2016; Fe et al., 2022; Alaoui and Penta, 2016). This pattern has been documented in experiments with children and adolescents, where repeated play interacts with cognitive development in shaping strategic sophistication (Czermak et al., 2016; Sutter et al., 2019). Building on this evidence, and as argued by Brocas and Carrillo (2020), designing a variant of the experiment in which subjects can discuss their strategies between rounds could further improve strategic decision-making beyond what can be achieved through mere observation of others' actions (Schotter and Sopher, 2003; Schotter, 2003). These extensions are particularly relevant for analysing how different logical processes operate and develop with experience, including inductive reasoning, deductive reasoning, counterfactual reasoning, and backward induction (Brocas and Carrillo, 2020).

Within feedback-based experimental designs, it would also be of interest to develop studies in which subjects receive information about their opponents, such as their performance in other tasks such as measures of cognitive abilities. Evidence from Gill and Prowse (2016) shows that individuals with higher cognitive abilities respond positively to the cognitive ability information of their opponents, whereas this pattern is not observed among individuals with lower scores in cognitive abilities.

Ultimately, the purpose of this line of research should extend beyond merely analysing strategic thinking and its relationship with cognitive abilities. Exper-

imental researchers should also aim to contribute to improving the skills of the populations they study. In this regard, given the evidence consistent with Fe et al. (2022) that cognitive abilities influence strategic sophistication, it becomes essential to explore how these skills can be enhanced. Following this perspective, Ashraf et al. (2020) show that training strategic skills among girls in developing countries helps them negotiate better educational resources from their parents. In this sense, it would be particularly valuable to further develop and implement such training interventions, as they hold the potential to improve overall well-being and reduce inequality gaps among vulnerable populations.

6.3 New variables to include

To obtain a broader understanding of strategic thinking and its determinants, Hermes and Schunk (2022) suggest that incorporating skills related to perspective-taking and empathy appears particularly promising. In this regard, studies such as Birch et al. (2017) provide evidence that individuals who score higher on *ToM* tasks (such as emotional understanding, perspective-taking, and false-belief reasoning) tend to display more prosocial behaviour (Deković and Gerris, 1994; Denham, 1986; Lalonde and Chandler, 1995; Nelson and Crick, 1999; Watson et al., 1999). Indeed, a meta-analysis of Imuta et al. (2016) shows that children aged 2 to 12 with higher *ToM* abilities are more likely to help, comfort others and cooperate in achieving common goals.

Moreover, higher levels of strategic performance are associated with better peer relationships, a link that appears to be driven by the connection between prosocial behaviour and peer acceptance (Caputi et al., 2012). Conversely, children with lower performance in strategic thinking tasks tend to be less positively evaluated by their peers (Dunn, 2014; Slaughter et al., 2002) and are more frequently involved in bullying situations, both as perpetrators and as victims (Renouf et al., 2010; Shakoor et al., 2012; Sutton et al., 1999). Such peer rejection may in turn hinder the development of the ability to recognize situations that require *ToM* (Banerjee et al., 2011).

Individual differences in strategic performance therefore provide valuable insight into the role of social interactions in its development. The study of this ability could be enriched by incorporating related skills such as language, memory, and inhibitory control, as well as environmental factors such as parental support and the presence of siblings (Birch et al., 2017). These relationships may have multiple explanations. For instance, differences in strategic abilities across individuals may reflect variation in underlying cognitive skills (such as language, memory, and inhibitory control) that facilitate its development. However, the precise nature of the interaction between these cognitive abilities and strategic interaction remains an open and widely debated question (Carlson and Moses, 2001; Carlson et al., 2004; Davis and Pratt, 1995; Flynn, 2007; Hala et al., 2003; Hughes, 1998; Landry et al., 2002; Moses and Carlson, 2004; Müller et al., 2012; Russell, 2013; Zelazo et al., 1997).

With respect to language, Jenkins and Astington (1996) argue that understanding strategic intentions and language develop jointly rather than independently. Their work highlights the importance of early language skills for cognitive and social development in children, while also pointing to the reverse relationship: early strategic abilities, such as the capacity to interpret and anticipate others' actions, are crucial for understanding many aspects of language. This may help explain why children with autism spectrum disorder (*ASD*) often experience language difficulties (Bloom, 2002). Consequently, individual differences in language ability are likely to be a strong factor in the variability observed in strategic performance.

Also, Hermes and Schunk (2022) argue that the early identification of gaps in strategic interaction linked to socioeconomic background could contribute to a better understanding of the intergenerational transmission of skills associated with inequality. In this context, comparing strategic behaviour across individuals from different socioeconomic backgrounds would be particularly informative for studying heritability. However, estimates of heritability tend to decline during the first ten years of life (Hughes and Devine, 2015), suggesting an opportunity to disentangle the

relative contributions of genetic and environmental factors in the development of strategic thinking in children.

For example, evidence from twin studies suggests that environmental factors play a significant role in the development of strategic abilities (Birch et al., 2017). Similar performance levels in these tasks related among twins highlight the importance of environmental input (Hughes et al., 2005). Beyond twin studies, children who grow up with older siblings tend to develop *ToM* abilities earlier than those without older siblings (Lewis et al., 1996; Ruffman et al., 1998).

More specifically, both the quantity and quality of language in children's environments, such as exposure to discussions about mental states including words like "want", "think" and "know", appear to contribute significantly to the development of strategic abilities (Dunn et al., 1991). This may help explain why deaf children whose hearing difficulties were not detected early, and who were therefore exposed to fewer conversational interactions, tend to lag behind their peers in understanding false beliefs (Peterson and Siegal, 2000).

For these reasons, it would be valuable to include measures of linguistic ability in experimental designs in order to examine the relationship between language development and strategic sophistication. Additionally, collecting sociodemographic information, such as household size, the presence of twins, and whether children have older or younger siblings, would provide further insight into these dynamics. Also, given the robust evidence linking prosocial behaviour and strategic sophistication, experimental designs could incorporate models of social preferences based on altruism, such as those proposed by Fehr et al. (2008).

Looking beyond, individual differences in strategic abilities can also lead to other types of consequences. As noted by Sutter et al. (2019), the literature on honest behavior among non-adult populations within economic experiments remains limited (see, for example, Bucciol and Piovesan (2011); Glätzle-Rützler and Lergetporer (2015); Houser et al. (2016); Maggian and Villeval (2016)). A deeper understand-

ing of the conditions under which individuals behave honestly when incentives to cheat are present would allow for greater insight into the role of social norms across different economic outcomes. In this context, it is plausible that individuals with higher strategic capacity may use this skill to their advantage in certain situations involving cognitively weaker counterparts. This opens up several relevant avenues for future research: whether such individuals adjust their behavior according to the perceived strategic ability of their opponents; whether they are more likely to exploit opponents with lower ability or to cooperate differently with those of equal or greater ability; and how these patterns may evolve throughout development, from childhood to adolescence. These questions could provide a solid foundation for future research on strategic thinking, cognitive skills and social norms in young populations.

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Part III

GENERAL CONCLUSIONS

This thesis is organised into three parts. Part I describes the methodology employed, distinguishing between the two types of experiments conducted. Two complementary methodologies were used: lab-in-the-field experiments, which provided the data for Study 1 of Chapter 3 and for Chapter 5, and laboratory experiments, which provided the data for Study 2 of Chapter 3 and for Chapter 4.

Part I also describes the subsamples mentioned above, which are used throughout Chapters 3, 4, and 5. Overall, the dataset comprises more than 5,000 observations from participants aged between 10 and 20 years, collected through projects led by *Loyola Behavioral Lab* within the *TeensLab* consortium, formed by different Spanish universities. Most of the data used in this thesis were collected by the author of the dissertation, who served as *Field Coordinator* in all the experiments included in this research project.

Part II focuses on the empirical analysis of the data through statistical and econometric inference, including OLS linear regression models, in order to address the main objectives of this thesis. The thesis seeks to shed light on how cognitive abilities and age influence strategic decision-making in adolescence population. The first objective is:

GO_1 To analyse how age and cognitive abilities are related to the deliberate use of different strategic coordination principles in coordination games in the adolescent population.

Chapter 3 focuses on a sample of 2,131 participants in Spain, combining 1,716 secondary school students from 20 schools (Study 1, ages 10–17) with 415 participants from laboratory sessions held at Universidad Loyola Andalucía (Study 2, ages 17–

20). It examines subjects' coordination ability in both a payoff-dominance game and a risk-dominance game, using an experimental design adapted to the wide age range analysed and understandable across all age groups considered. In addition to the actions chosen by participants, the study also collected the arguments used to justify those decisions, allowing the distinction between choices merely consistent with equilibrium play and choices deliberately based on strategic coordination principles.

The main results reveal a sharp developmental asymmetry between the two coordination principles: payoff-based coordination is already prevalent at the earliest ages studied and remains stable across age groups, with similar trajectories across cognitive ability and gender groups, whereas risk-based coordination emerges gradually and increases with age, with a developmental gradient concentrated among high-ability individuals and largely driven by males. These findings help reconcile apparently contradictory evidence in the literature. On the one hand, they are consistent with Glätzle-Rützler et al. (2025), who find no age effects in one-shot strategic games when considering payoff-based coordination. On the other hand, they are also in line with Brocas and Carrillo (2025), whose results point to a stronger tendency towards risk-based coordination with age among children and adolescents. This raises the question of whether these findings depend on the use of hypothetical incentives, which leads to the second objective of this thesis:

GO_2 To analyse whether the use of monetary and hypothetical incentives affects the measurement of strategic behaviour in coordination games.

To address this objective, the same experimental games used in Chapter 3 were implemented in a randomised controlled trial (RCT) comprising two studies, with 242 and 301 participants, respectively. In both studies, randomisation was conducted at the individual level. In the first study, participants were randomly assigned to treatment and control groups in order to compare differences in strategic performance under monetary versus hypothetical incentives. In the second study, a 2×2 design was implemented, where participants were not only assigned to monetary versus hy-

pothetical incentive conditions, but also randomly assigned to different game orders, allowing for the analysis of potential order effects. The studies involved high-school visitors attending university open-day events together with undergraduate students of Universidad Loyola Andalucía.

The results indicate no significant differences either in coordination decisions or in the arguments used to justify them across incentive schemes. Likewise, no evidence of order effects was found. These findings are consistent with previous research showing no substantial differences between real and hypothetical incentives in economic experiments (Brañas-Garza et al., 2021; Brañas-Garza et al., 2023). Overall, the evidence suggests that hypothetical incentives may constitute a valid tool for studying strategic behaviour in coordination games.

A further research question concerns whether the relationships observed between cognitive abilities, age, and strategic behaviour remain stable across alternative experimental settings. This leads to the third objective of the thesis:

GO_3 To analyse the effect of cognitive abilities on strategic behaviour in static and dynamic games adapted to the adolescent population.

To address this objective, two additional subsamples were collected using two experimental designs that capture, respectively, a static and a dynamic strategic environment: a one-shot, two-player adaptation of the Beauty Contest Game (static) and a dynamic accumulation game grounded in the Chicken Game and the War of Attrition framework. The samples include 2,718 and 653 participants, respectively, drawn from a total of 13 secondary schools in in Andalusia (Spain).

To examine the relationship between cognitive abilities and strategic thinking, the analysis goes beyond outcomes based on *Nash* equilibrium play and incorporates additional measures, such as deviations from equilibrium (*Trembling*) and distance from equilibrium play (*Rationality*). Cognitive abilities were measured through a composite index (*CogAb*) constructed from three complementary tasks: a Cognitive Reflection Test (CRT), a three-question test on financial and numerical literacy, and

three additional items measuring probabilistic reasoning.

The main findings confirm that cognitive abilities are a key determinant of strategic thinking in both static and dynamic strategic environments. Furthermore, individuals are more likely to play the best response in the adapted *Beauty Contest Game* than in the dynamic accumulation game, although the relationship between cognitive ability and strategic reasoning is stronger in the latter. Finally, no significant age effects are found for any of the dependent variables analysed in these competitive games, in line with the developmental stability documented for payoff-based coordination in Chapter 3 and with the absence of age effects observed in Chapter 4.

Finally, Chapter 6 outlines directions for future research, including the analysis of new data from El Salvador, potential modifications to the experimental designs, and the inclusion of additional variables that, based on the existing literature, are expected to be relevant for understanding strategic thinking.

Part

APPENDICES

Appendix A

Chapter 3

A.1 Experimental design and instructions

A.1.1 Overview of studies

The paper draws on two studies that share the same experimental paradigm: two one-shot coordination games followed by a stated justification for each choice. The two studies share the same game design and instructions (see Section A.1.2) but differ in setting and population: Study 1 is a lab-in-the-field experiment with secondary school students (ages 10–17); Study 2 consists of laboratory sessions with university-age participants (ages 17–20).

Study 1 — Lab-in-the-field, TeensLab. Study 1 constitutes a subsample of the TeensLab dataset (see Vasco et al. (2025) for details), a large-scale initiative by a consortium of Spanish universities dedicated to behavioral research with adolescents, whose data are publicly available in Vasco et al. (2025). Rather than inviting participants to a lab, we took the experiment to them. A total of 1716 students participated in this study. Between January 2023 and May 2023, we visited 20 secondary schools across two Spanish provinces — Barcelona (19 schools, 91.2% of the sample) and Cádiz (1 school, 8.8%) — and ran sessions directly inside the classrooms, with students sitting at their usual desks.

The participant pool was recruited through agreements with school headmasters,

who agreed to integrate the experiment into their pedagogical curriculum and to carry it out as a classroom activity. The experiment was approved by the Ethical Committee of Universidad Loyola Andalucía (No. 20190318, 20200709 and 20230301) under an opt-out IRB consent procedure.

Participants ranged from grades 5 to 11 (ages 10–17), all enrolled in *Educación Secundaria Obligatoria* (Secondary Education in Spain) and High School. Students in vocational training programs were also recruited, reaching a total of 111 students. Additionally, 58 undergraduate students from Universidad Loyola Andalucía participated in the study as a pilot representing 3.38% of the Study 1 total sample. These university participants were aged up to 20 years old. The experiment was conducted as a regular class activity using a self-administered questionnaire programmed in a tailored online platform named SAND.[1] Subjects answered on their computers, tablets, or mobile phones with guaranteed anonymity. Throughout the main sample, payoffs were hypothetical — a deliberate choice justified by evidence that adolescents do not alter their behavior when real money is introduced (Alfonso et al., 2025).

Study 2 — Laboratory experiments. The data for Study 2 are drawn from three sessions of a laboratory experiment described in full detail in Brañas-Garza et al. (2026). All were conducted at Universidad Loyola Andalucía in designated classrooms, where participants read the instructions and made their decisions using their own mobile phones via a Qualtrics survey. Incentives were randomized at the individual level ($p = 1/2$): each participant was assigned to either a monetary or a hypothetical payment condition. Participants assigned to the hypothetical condition were not left empty-handed: the Theory of Mind task was incentivized for them, ensuring every participant had a realistic chance of earning money regardless of their assigned condition.

The first two sessions (November 2023 and November 2024, $n = 242$ in the original

[1] SAND (Social Analysis and Network Data; `https://sand.kampal.com`) is a tailored online platform designed for data collection in educational settings, enabling privacy-preserving management of large simultaneous classroom sessions.

sample) combined two groups: 137 high school students visiting the university on an open-day event, and 105 university undergraduates enrolled at Loyola. It should be noted that the high school visitors were students who attended a university open day as a class activity of their high school. Games were presented in a fixed order (Game 1 $\rightarrow$ Game 2). Average earnings were €2.19, including a €1 show-up fee, for a session lasting under 10 minutes.

The third session (November–December 2024, $n = 301$ in the original sample) restricted recruitment to Loyola University students only and additionally randomized game order at the individual level. This double randomization — incentive scheme and game sequence — rules out the order and composition confounds that the first two sessions could not fully control. Average earnings were €1.98, again for under 10 minutes of participation. Brañas-Garza et al. (2026) show that neither game order nor the distinction between sessions affects outcomes.

For the purposes of this paper, we retain participants aged 17–20, excluding those above age 20 due to small cell sizes, as well as a small number of participants misclassified or enrolled as grade repeaters in secondary education. This yields a pooled Study 2 sample of $n = 415$.[2]

A.1.2 Game design

Both games are one-shot, 2×2 coordination games with two pure-strategy Nash equilibria. Participants are told they are paired with another person in the room (someone they cannot see or communicate with) and must press one of two colored buttons simultaneously. What makes the games interesting is that the two equilibria differ in the reasoning they require: one game has a clear payoff-dominant equilibrium, while the other has a risk-dominant equilibrium. The payoff values below correspond to Study 1; in Study 2 the same amounts were divided by 10, which leaves all the equilibrium structure intact.

[2] In Study 1 (TeensLab), both games were always presented in the same order: Game 1 first. This was a deliberate design choice — by exposing participants to Game 2 after Game 1, we gave RiskD its best chance, since subjects may transfer the reasoning learned in Game 1. In the third session of Study 2, game order was randomized to rule out order effects entirely; Brañas-Garza et al. (2026) confirm these have no effect on outcomes.

Game 1 — Payoff-dominant equilibrium (*PayD*). Players choose between Yellow and Red. Pressing Yellow when the other person also presses Yellow gives both players 10 euros; pressing Red when the other also presses Red gives both 5 euros; and any mismatch leaves both with nothing. See payoff matrix in Table A.1.

Table A.1: Game 1 — Payoff-dominant coordination game.

	Yellow (A)	**Red (B)**
Yellow (A)	**10, 10**	0, 0
Red (B)	0, 0	5, 5

The logic here is: Yellow/Yellow Pareto-dominates Red/Red, and any reasonable player who expects the other to think the same way should choose Yellow.

After each game, participants were asked to choose one of four predefined reasons for their decision, presented in random order. For Game 1:

(a) Because I earned more;

(b) Because I earned less;

(c) Because I liked the colour;

(d) I chose one randomly.

We define *PayD* as the indicator for pressing Yellow *and* explaining the choice with "*Because I earned more*". This conjunction ensures we are identifying participants who are consciously playing the payoff-dominant equilibrium, not just pressing a button at random.

Game 2 — Risk-dominant equilibrium (*RiskD*). Players choose between White and Blue. Both White/White and Blue/Blue pay $(10, 10)$, so payoffs cannot guide the decision. The difference shows up only in miscoordination: pressing White when the other presses Blue gives you 5 euros and them nothing; pressing Blue

when the other presses White gives you nothing and them 5 euros. White is therefore the risk-dominant choice. See payoff matrix of Game 2 in Table A.2.

Table A.2: Game 2 — Risk-dominant coordination game.

	White (A)	**Blue (B)**
White (A)	**10, 10**	5, 0
Blue (B)	0, 5	10, 10

For Game 2, the four predefined reasons were:

(a) Because it was less risky;

(b) Because it was more risky;

(c) Because I liked the colour;

(d) I chose one randomly.

We define *RiskD* as pressing White *and* choosing the reasoning "*Because it was less risky*". Again, the conjunction is essential: it filters out participants who happen to press White for aesthetic reasons or by pure chance.

The full experimental sequence was always: Game 1 → Explanation 1 → Game 2 → Explanation 2 (with game order randomized only in session 3 of Study 2).

A.1.3 Instructions

Below we reproduce the exact text shown to participants on each of the six screens. The wording is identical across both studies; the amounts shown in the instructions were divided by 10 for Study 2, leaving all the equilibrium structure intact. In Study 1, the screens appeared in Spanish; the following is a faithful English translation. Button colors were not randomized: the equilibrium options were always Yellow for Game 1 and White for Game 2, ensuring the salience structure was consistent across participants. Button positions — left or right — were randomized independently for each participant to prevent any systematic positional bias.

Figure A.1: Game 1 screenshots

Screen 1 (Introduction):

You will now be paired with a random partner.

Both of you will need to press a button without being able to communicate with each other.

Depending on what each of you chooses, you will receive different (hypothetical) rewards.

[Click the forward button to move on to the first question.]

Screen 2 (Game 1 — payoff matrix):

These are the possible outcomes:

If you press yellow and she/he presses yellow, you both win 10 euros each.

If you press yellow and she/he presses red, you both win 0 euros each.

If you press red and she/he presses yellow, you both win 0 euros each.

If you press red and she/he presses red, you both win 5 euros each.

Which button do you press?

Screen 3 (Explanation 1):

Why did you choose the previous button?

○ Because I earned more

○ Because I earned less

○ Because I liked the colour

○ I chose one randomly

Figure A.2: Game 2 screenshots

Screen 4 (Transition):

Now you are going to play again with another person, other buttons, and other prizes.

Again, you have to choose a button without knowing what the other one does.

Screen 5 (Game 2 — payoff matrix):

These are the possible outcomes:

If you press white and she/he presses white, you both win 10 euros each.

If you press white and she/he presses blue, you will earn 5 euros and she/he will win 0 euros.

If you press blue and she/he presses blue, you both win 10 euros each.

If you press blue and she/he presses white, you will earn 0 euros and she/he will win 5 euros.

Which button do you press?

Screen 6 (Explanation 2):

Why did you choose the previous button?

○ Because it was less risky

○ Because it was more risky

○ Because I liked the colour

○ I chose one randomly

A.1.4 Tasks

Beyond the two coordination games, participants completed a short battery of tasks designed to capture cognitive abilities and, in the developmental sample, individual risk preferences. The battery was not identical across studies — some tasks require a minimum level of abstraction that makes them unsuitable for 10-year-olds, and others are redundant once we have university students. Table A.3 summarizes which tasks appeared where.

Table A.3: Tasks administered in each study.

Task	Study 1 (TeensLab)	Study 2 (Qualtrics)
Cognitive Reflection Test (CRT)	✓	✓
Financial Abilities (FinAb)	✓	—
Probabilistic Reasoning (Del)	✓	—

A.1.4.1 Cognitive Reflection Test (CRT)

The CRT was administered in both studies. We used the adaptation by Thomson and Oppenheimer (2016), as in Alfonso et al. (2025), which preserves the spirit of Frederick (2005)'s original three-item test while reducing reliance on domain-specific vocabulary that could disadvantage younger or less math-oriented respondents. Each item has a tempting intuitive answer that is wrong, and the correct answer requires a moment of deliberate reflection. Items were randomized in order. The score runs from 0 (all intuitive) to 3 (all reflective). The three items are reproduced below.

Figure A.3: CRT questions

Q1. Emilia's father has three daughters. The first two are named April and May. What is the name of the third daughter?

(Reflective: **Emilia**; Intuitive: June)

Q2. If you are running a race and you overtake the person in second place, what position are you in? Indicate with a number (e.g., 1 = first, 2 = second, etc.).

(Reflective: **2**; Intuitive: 1)

Q3. In a library, the number of books doubles every month. If it takes 48 months for the library to become full, how many months would it take for it to be half full? Indicate with a number.

(Reflective: **47**; Intuitive: 24)

A.1.4.2 Financial Abilities (FinAb)

In Study 1, we complemented the CRT with a short financial literacy task.[3] The three items require basic arithmetic with money and an understanding of how interest compounds over time. Scores run from 0 to 3.

[3]Items are drawn from Alfonso et al. (2025). They span basic arithmetic with money and simple compound interest, and were calibrated so as not to require knowledge beyond the primary school curriculum.

Figure A.4: *FinAb* questions

Q1. You have 5 euros and you spend 3 euros. How many euros do you have left?

(Correct answer: **2 euros**)

Q2. You put 100 euros in a savings account. The bank gives you 10% interest per year. How much money will you have after one year?

(Correct answer: **110 euros**)

Q3. You put 100 euros in a savings account that pays 10% interest per year. You leave the money there for two years without withdrawing anything. How much will you have at the end of the second year?

(Correct answer: **121 euros**)

A.1.4.3 Probabilistic Reasoning (Del)

Three probabilistic reasoning items (*Del*) adapted from Delavande and Rohwedder (2008) were administered exclusively in Study 1. Participants received one point for each item in which they correctly respected a basic probabilistic relation, for a total score ranging from 0 to 3. The three scored comparisons were: (i) stating that the probability of drawing the green apple from a basket of 5 (1 green, 4 red) is higher than from a basket of 10 (1 green, 9 red); (ii) stating that the probability of eating rice in the next month is higher than in the next week; and (iii) stating that the probability of showering at least once in the next month is higher than the probability of not attending school for a single day in the same period. Violations occur when the reported probability for the broader or more likely event is numerically lower than that for the narrower or less likely event.

Participants responded by entering a number from 0 to 100 (50% of participants) or by moving a slider on a 0–100 scale (50% of participants); randomization was at the individual level. The instructions and questions were identical across both response formats. Questions (Q1–Q6) are shown below.

The slider version (used by 50% of participants, randomized at the individual level) presented the same questions and instructions, with participants dragging a marker along a 0–100 scale ("Valor: 50" shown by default) instead of typing a number. See Figure A.6 for an illustration of the slider interface.

Figure A.5: *Del* screenshots

Screen 1 — Instructions

In the next screen, we **will ask you** about the **probability** that certain things could happen. In each question, you should **write down** how **likely you think** it is that these things will happen in reality.

If you think something will happen for **sure**, you should write **100**. If you are fairly but not completely sure, write a number close to 100 (but less than 100). If you think it is something that will **never** happen, write **0**. If you think it is unlikely, write a number close to 0 (but greater than 0). If you think it is **equally likely** to happen or not to happen, write **50**.

Screen 2 — Examples

EXAMPLES:

• If it is a sunny day and I ask you how likely it is that it will be sunny within 1 hour, you would typically say 100 or numbers very close to 100.

• If it is 12 o'clock at night, the most reasonable thing to say is that the probability that it will be sunny in 1 hour is 0.

• If I flip a coin, the probability that it will come up heads is 50.

***Del* questions (2 by screen)**

Q1. Imagine that I have a basket with 5 apples: 1 green and 4 red. If I ask you to choose one of the apples without looking inside the basket, how likely is it that you pick the green apple, from 0 to 100?

Q2. Imagine that I have a basket with 10 apples: 1 green and 9 red. If I ask you to choose one of the apples without looking inside the basket, how likely is it that you pick the green apple, from 0 to 100?

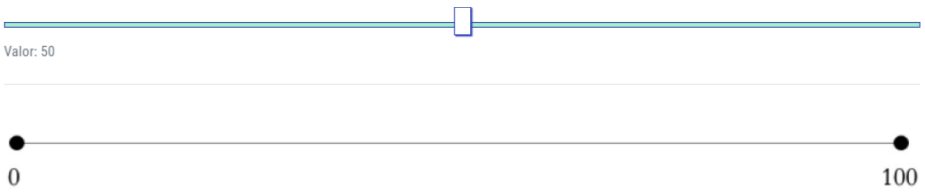
Q3. How likely is it that you eat rice in the next week from 0 to 100? (Including today)

Q4. How likely is it that you eat rice in the next month from 0 to 100? (Including today)

Q5. How likely is it that you do not attend your educational center even once in the next month from 0 to 100? (Including today)

Q6. How likely is it that you take a shower at least once during the next month from 0 to 100? (Including today)

Figure A.6: Slider interface.



Note: Screenshot of the slider response format used by half of the participants in the probabilistic reasoning task. Participants dragged a marker along a 0–100 scale; the default position was 50 ("Valor: 50"). The other half of participants typed a number directly.

A.2 Sample composition

This appendix provides a full breakdown of participants across both studies. The samples span a wide range of educational stages, from late primary school to university, generating substantial variation in age, cognitive development, and educational experience. Each study's sample is described along two complementary dimensions. First, we report age in years (Tables A.4 and A.6), which provides a continuous developmental scale that facilitates comparison across cohorts and studies. Second, we report participants' academic track or grade (Tables A.5 and A.7), which reflects the structure of the educational system used for recruitment. In the Spanish system, grades 5–6 correspond to late primary education, grades 7–10 to compulsory secondary education, and grades 11–12 to academic high school. Vocational training (VT) and university (U) students are reported as separate categories, as they represent distinct educational pathways relative to the standard academic track. Table A.8 presents the distribution of our full sample by age in years.

Table A.4: Study 1 — Sample distribution by age.

	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total**
N	136	208	237	276	300	244	124	24	78	53	36	**1,716**
% of sample	7.9%	12.1%	13.8%	16.1%	17.5%	14.2%	7.2%	1.4%	4.6%	3.1%	2.1%	**100.0%**
% Female	53.7%	51.4%	43.5%	46.0%	47.0%	52.5%	43.5%	50.0%	60.3%	43.4%	55.6%	**48.7%**

Table A.5: Study 1 — Sample distribution by grade.

	5th	**6th**	**7th**	**8th**	**9th**	**10th**	**11th**	**12th**	**VT**	**U**	**Total**
N	173	213	259	299	340	190	73	–	111	58	**1,716**
% of sample	10.1%	12.4%	15.1%	17.4%	19.8%	11.1%	4.2%	–	6.5%	3.4%	**100.0%**
% Female	53.8%	47.4%	47.5%	45.8%	45.6%	53.2%	46.6%	–	70.3%	22.4%	**48.7%**

Table A.6: Study 2 — Sample distribution by age.

	17	**18**	**19**	**20**	**Total**
N	119	79	144	73	**415**
% of sample	28.7%	19.0%	34.7%	17.6%	**100.0%**
% Female	54.6%	40.5%	47.2%	46.3%	**46.3%**

Table A.7: Study 2 — Sample distribution by grade.

	12th	University	Total
N	119	296	**415**
% of sample	28.7%	71.3%	**100.0%**
% Female	54.6%	42.9%	**46.3%**

Table A.8: Full sample — All studies combined, by age.

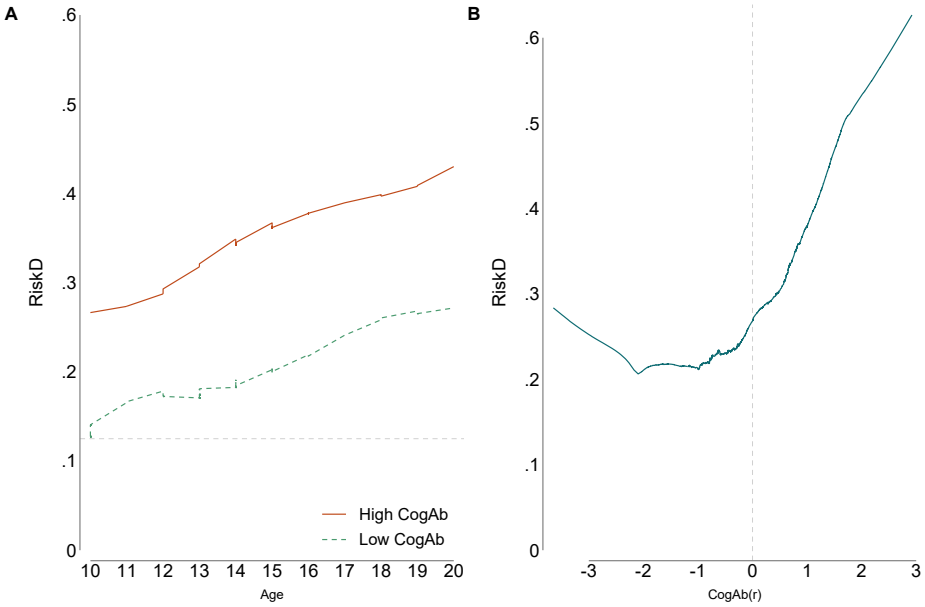
	10	11	12	13	14	15	16	17	18	19	20	Total
N	136	208	237	276	300	244	124	143	157	197	109	**2,131**
% of sample	6.4%	9.8%	11.1%	12.9%	14.1%	11.4%	5.8%	6.7%	7.4%	9.2%	5.1%	**100.0%**
% Female	53.7%	51.4%	43.5%	46.0%	47.0%	52.5%	43.5%	53.8%	50.3%	46.2%	43.1%	**48.3%**

A.3 Additional data analysis

A.3.1 Non-parametric analysis of risk-based coordination

Figure A.7 presents non-parametric lowess (Locally Weighted Scatterplot Smoothing) estimates of the relationship between RiskD and two key predictors. Panel A shows smoothed RiskD trajectories by age separately for high- and low-ability individuals (bandwidth = 0.8). The developmental gradient for high-ability individuals is steeper and emerges earlier, rising continuously from age 10, while low-ability individuals display a more gradual increase that accelerates only in the later stages of the developmental window. Panel B shows the smoothed relationship between RiskD and age-residualized cognitive ability CogAb(r) across the full sample (bandwidth = 0.6). The relationship is markedly non-linear: RiskD remains largely flat below the median (CogAb(r) $= 0$, dashed vertical line) and rises sharply above it, motivating the inclusion of the quadratic term CogAb(r)^2 in columns 4 and 8 of Table 1.

Figure A.7: Lowess-smoothed relationships between deliberate risk-based coordination, age, and cognitive ability.



We further explore the relationship between cognitive ability and risk-dominant reasoning. Figure A.7 shows that RiskD increases monotonically with age and is consistently higher among individuals with greater cognitive ability. This pattern is not driven by arbitrary group definitions: exploiting the full continuous variation in cognitive ability reveals a non-linear relationship, with a marked increase in RiskD above the sample mean.

Taken together, these results suggest that risk-dominant coordination is cognitively demanding and becomes more prevalent as individuals develop both in age and cognitive ability. Importantly, this pattern complements the age gradients documented above, indicating that developmental changes in RiskD are not solely driven by age per se but are closely linked to underlying cognitive skills.

A.3.2 Robustness checks and additional regression analysis

Table A.14 replicates Table 1 using MICE-PMM imputation ($M = 20$). All main findings are qualitatively unchanged. The age gradient in RiskD remains positive and significant across all specifications, and cognitive ability remains a strong pos-

Table A.9: OLS regression for the sub-sample: Late primary + Secondary.

	(1) PayD	(2) PayD	(3) PayD	(4) PayD	(5) RiskD	(6) RiskD	(7) RiskD	(8) RiskD
Age	0.009	0.009	0.007	0.009	0.015	0.015	0.015	0.015
	(0.011)	(0.011)	(0.013)	(0.011)	(0.010)	(0.010)	(0.012)	(0.010)
CogAb(r)	0.093***	−0.078	0.093***	0.092***	0.087***	0.014	0.087***	0.087***
	(0.014)	(0.119)	(0.014)	(0.014)	(0.013)	(0.103)	(0.013)	(0.013)
Female	−0.035	−0.034	−0.092	−0.037	−0.021	−0.020	−0.008	−0.020
	(0.025)	(0.025)	(0.192)	(0.025)	(0.023)	(0.023)	(0.173)	(0.023)
Age × CogAb(r)		0.013				0.006		
		(0.009)				(0.008)		
Age × Female			0.004				−0.001	
			(0.015)				(0.013)	
CogAb(r)^2				−0.014				0.005
				(0.013)				(0.011)
Constant	0.425*	0.411*	0.451*	0.427*	0.179	0.174	0.174	0.179
	(0.227)	(0.227)	(0.244)	(0.226)	(0.208)	(0.209)	(0.221)	(0.208)
Observations	1,474	1,474	1,474	1,474	1,462	1,462	1,462	1,462
R-squared	0.083	0.085	0.083	0.084	0.062	0.063	0.062	0.063
BIC	2108.8	2113.9	2116.0	2114.9	1812.6	1819.4	1819.9	1819.7
School FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: All specifications include school fixed effects and baseline controls (repeater status, class size, and monetary incentives). Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

itive predictor of both outcomes. In column 6, the coefficient on CogAb(r) is 0.092 ($p = 0.106$), compared to 0.138 ($p < 0.01$) in Table 1 — the difference reflects the additional uncertainty introduced by imputation for university participants rather than a change in the underlying effect. All interaction terms retain their sign and direction.

Table A.10: OLS regression for the sub-sample: Late primary + Secondary + High School.

	(1) PayD	(2) PayD	(3) PayD	(4) PayD	(5) RiskD	(6) RiskD	(7) RiskD	(8) RiskD
Age	0.015	0.015	0.012	0.015	0.021**	0.021**	0.029***	0.021**
	(0.010)	(0.010)	(0.012)	(0.010)	(0.009)	(0.009)	(0.011)	(0.009)
CogAb(r)	0.085***	0.073	0.085***	0.084***	0.080***	0.122	0.080***	0.081***
	(0.013)	(0.095)	(0.013)	(0.013)	(0.012)	(0.085)	(0.012)	(0.012)
Female	−0.032	−0.031	−0.117	−0.033	−0.040*	−0.040*	0.168	−0.038*
	(0.023)	(0.024)	(0.161)	(0.024)	(0.022)	(0.022)	(0.147)	(0.022)
Age × CogAb(r)		0.001				−0.003		
		(0.007)				(0.006)		
Age × Female			0.006				−0.015	
			(0.012)				(0.011)	
CogAb(r)^2				−0.009				0.011
				(0.011)				(0.010)
Constant	0.588***	0.587***	0.629***	0.594***	0.114	0.118	0.013	0.106
	(0.161)	(0.161)	(0.179)	(0.161)	(0.149)	(0.150)	(0.165)	(0.149)
Observations	1,666	1,666	1,666	1,666	1,653	1,653	1,653	1,653
R-squared	0.076	0.076	0.076	0.077	0.060	0.060	0.061	0.061
BIC	2397.8	2405.2	2404.9	2404.5	2097.3	2104.4	2102.6	2103.4
School FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: All specifications include school fixed effects and baseline controls (repeater status, class size, and monetary incentives). Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.11: OLS regression for the sub-sample: Late primary + Secondary + High School + Vocational.

	(1) PayD	(2) PayD	(3) PayD	(4) PayD	(5) RiskD	(6) RiskD	(7) RiskD	(8) RiskD
Age	0.016	0.016	0.016	0.016	0.021**	0.021**	0.024**	0.021**
	(0.010)	(0.010)	(0.011)	(0.010)	(0.009)	(0.009)	(0.010)	(0.009)
CogAb(r)	0.084***	0.087	0.084***	0.083***	0.082***	0.100	0.081***	0.083***
	(0.013)	(0.082)	(0.013)	(0.013)	(0.012)	(0.073)	(0.012)	(0.012)
Female	−0.036	−0.036	−0.043	−0.038*	−0.034	−0.034	0.042	−0.032
	(0.023)	(0.023)	(0.140)	(0.023)	(0.021)	(0.021)	(0.124)	(0.021)
Age × CogAb(r)		−0.000				−0.001		
		(0.006)				(0.005)		
Age × Female			0.001				−0.006	
			(0.010)				(0.009)	
CogAb(r)^2				−0.013				0.014
				(0.011)				(0.010)
Constant	0.572***	0.572***	0.575***	0.581***	0.108	0.109	0.070	0.097
	(0.159)	(0.159)	(0.173)	(0.159)	(0.147)	(0.148)	(0.159)	(0.148)
Observations	1,777	1,777	1,777	1,777	1,764	1,764	1,764	1,764
R-squared	0.084	0.084	0.084	0.085	0.061	0.061	0.062	0.063
BIC	2561.2	2568.7	2568.7	2567.3	2233.1	2240.5	2240.2	2238.3
School FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: All specifications include school fixed effects and baseline controls (repeater status, class size, and monetary incentives). Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.12: OLS regressions of deliberate coordination on age, cognitive ability, and gender.

	(1) PayD	(2) PayD	(3) RiskD	(4) RiskD
Age	0.021**	0.021**	0.030***	0.029***
	(0.010)	(0.010)	(0.009)	(0.009)
CogAb(r)	0.163***	0.157***	0.135***	0.106**
	(0.054)	(0.056)	(0.050)	(0.051)
Female	0.030	0.028	0.127	0.120
	(0.108)	(0.108)	(0.099)	(0.099)
CogAb(r)^2		0.003		0.017**
		(0.008)		(0.008)
Age × CogAb(r)	−0.006*	−0.005	−0.005	−0.002
	(0.003)	(0.004)	(0.003)	(0.003)
Age × Female	−0.005	−0.005	−0.012*	−0.012*
	(0.007)	(0.007)	(0.007)	(0.007)
Age × Female × CogAb(r)	−0.000	−0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.547***	0.545***	0.046	0.036
	(0.158)	(0.158)	(0.147)	(0.147)
Observations	2,131	2,131	2,118	2,118
R-squared	0.080	0.080	0.068	0.070
BIC	3053.4	3060.9	2756.0	2758.5
School FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y

Note: All specifications include school fixed effects and baseline controls (repeater status, class size, and monetary incentives). Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.13: Logit regressions of deliberate coordination on age, cognitive ability, and gender.

	(1) PayD	(2) PayD	(3) PayD	(4) PayD	(5) RiskD	(6) RiskD	(7) RiskD	(8) RiskD
Age	0.019**	0.018*	0.021**	0.018**	0.025***	0.025***	0.029***	0.025***
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)
CogAb(r)	0.067***	0.156***	0.067***	0.071***	0.069***	0.170***	0.068***	0.072***
	(0.010)	(0.055)	(0.010)	(0.011)	(0.010)	(0.052)	(0.010)	(0.009)
Female	−0.048**	−0.049**	0.038	−0.046**	−0.051***	−0.052***	0.108	−0.047**
	(0.021)	(0.021)	(0.108)	(0.021)	(0.019)	(0.019)	(0.102)	(0.019)
Age × CogAb(r)		−0.006*				−0.006*		
		(0.003)				(0.003)		
Age × Female			−0.006				−0.011	
			(0.007)				(0.007)	
CogAb(r)^2				0.009				0.016**
				(0.008)				(0.007)
Observations	2,131	2,131	2,131	2,131	2,118	2,118	2,118	2,118
CogAbB2	No	No	No	Yes	No	No	No	Yes
School FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: All specifications include school fixed effects and baseline controls (repeater status, class size, and monetary incentives). Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table A.14: Replication of Table 1 using multiple imputation by chained equations (MICE-PMM, $M = 20$ datasets).

	(1) PayD	(2) PayD	(3) PayD	(4) PayD	(5) RiskD	(6) RiskD	(7) RiskD	(8) RiskD
Age	0.019**	0.019**	0.022**	0.019**	0.024***	0.024***	0.031***	0.024***
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
CogAb(r)	0.073***	0.101*	0.072***	0.072***	0.073***	0.092	0.072***	0.074***
	(0.011)	(0.061)	(0.011)	(0.011)	(0.010)	(0.057)	(0.010)	(0.010)
Female	−0.045**	−0.046**	0.035	−0.046**	−0.052***	−0.052***	0.135	−0.050**
	(0.021)	(0.021)	(0.108)	(0.021)	(0.020)	(0.020)	(0.101)	(0.020)
Age × CogAb(r)		−0.002				−0.001		
		(0.004)				(0.004)		
Age × Female			−0.006				−0.013*	
			(0.007)				(0.007)	
CogAb(r)^2				−0.005				0.011
				(0.009)				(0.008)
Constant	0.573***	0.575***	0.536***	0.579***	0.121	0.122	0.033	0.109
	(0.147)	(0.147)	(0.155)	(0.148)	(0.139)	(0.139)	(0.146)	(0.139)
Observations	2,131	2,131	2,131	2,131	2,118	2,118	2,118	2,118
Imputation	MICE-PMM	MICE-PMM	MICE-PMM	MICE-PMM	MICE-PMM	MICE-PMM	MICE-PMM	MICE-PMM
M	20	20	20	20	20	20	20	20
School FE	Y	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y	Y

Note: All specifications include school fixed effects and baseline controls (repeater status, class size, and monetary incentives). Robust standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

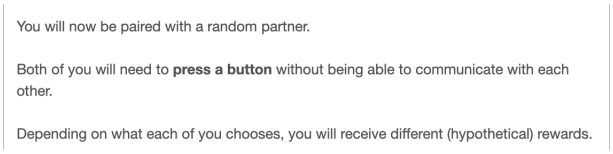
Appendix B

Chapter 4

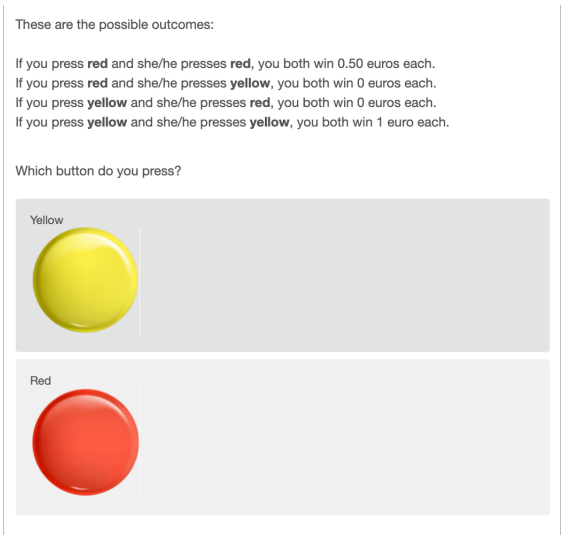
B.1 Instructions

Figure B.1: Screenshots of Game 1

Screen 1



Screen 2



Screen 3

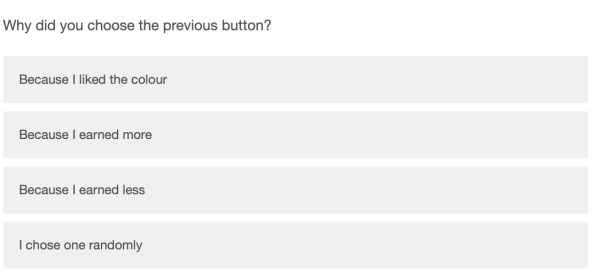
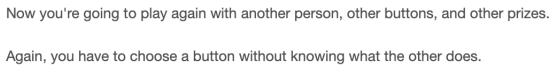
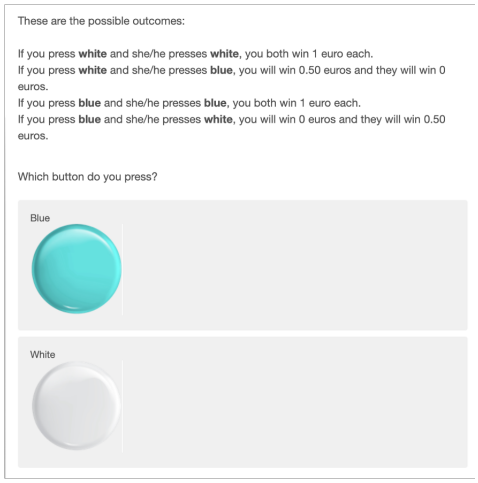


Figure B.2: Screenshots of Game 2

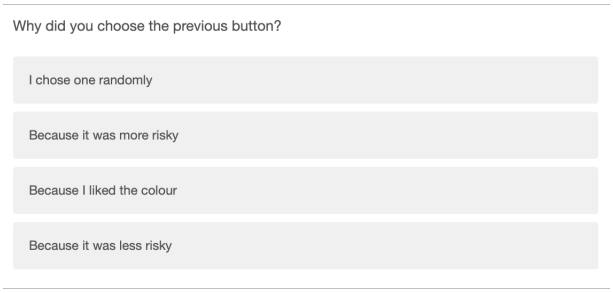
Screen 1



Screen 2



Screen 3



The ToM task consists of 10 images of a child's eyes expressing different emotions, each accompanied by four possible answers, one of which best represents the depicted emotion. Figures B.3 and B.4 illustrate the items of the this task. Correct answers are shown in bold. The order of the items was randomized.

Figure B.3: ToM (Theory of Mind): Questions 1–5

Q1

A. Tired B. Scheming
C. Angry D. Guilty

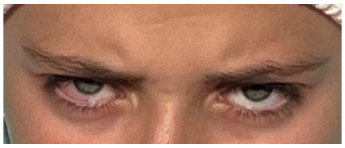
Q2

A. Happy B. Surprised
C. Admiring D. Scheming

Q3

A. Embarrassed B. Confused
C. Scared D. Tired

Q4



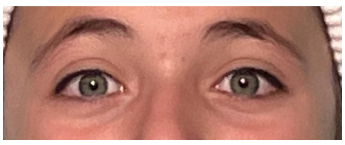
A. Angry B. Scared
C. Sad D. Worried

Q5

A. Flirting B. Excited
C. Confused D. Thoughtful

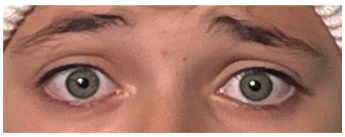
Figure B.4: ToM (Theory of Mind): Questions 6–10

Q6



A. Excited B. Happy
C. Hopeful D. Flirting

Q7



A. Scared B. Disgusted
C. Angry D. Sad

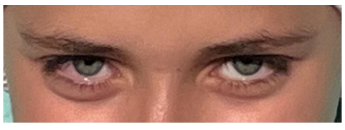
Q8

A. Disgusted B. Scared
C. Bored D. Angry

Q9

A. Thoughtful B. Surprised
C. Happy D. Disapproving

Q10



A. Scheming B. Hopeful
C. Thoughtful D. Excited

The items used in the CRT task are shown in Figure C.2. Reflective and intuitive answers are shown in parentheses. The order of the items was randomized.

Figure B.5: CRT questions

Q1. Emilia's father has three daughters. The first two are named April and May. What is the name of the third daughter? (**Reflective: Emilia**; Intuitive: June)

Q2. If you are running a race and you overtake the person in second place, what position are you in? Indicate with a number. For example: 1 (first), 2 (second), etc. (**Reflective: 2**; Intuitive: 1)

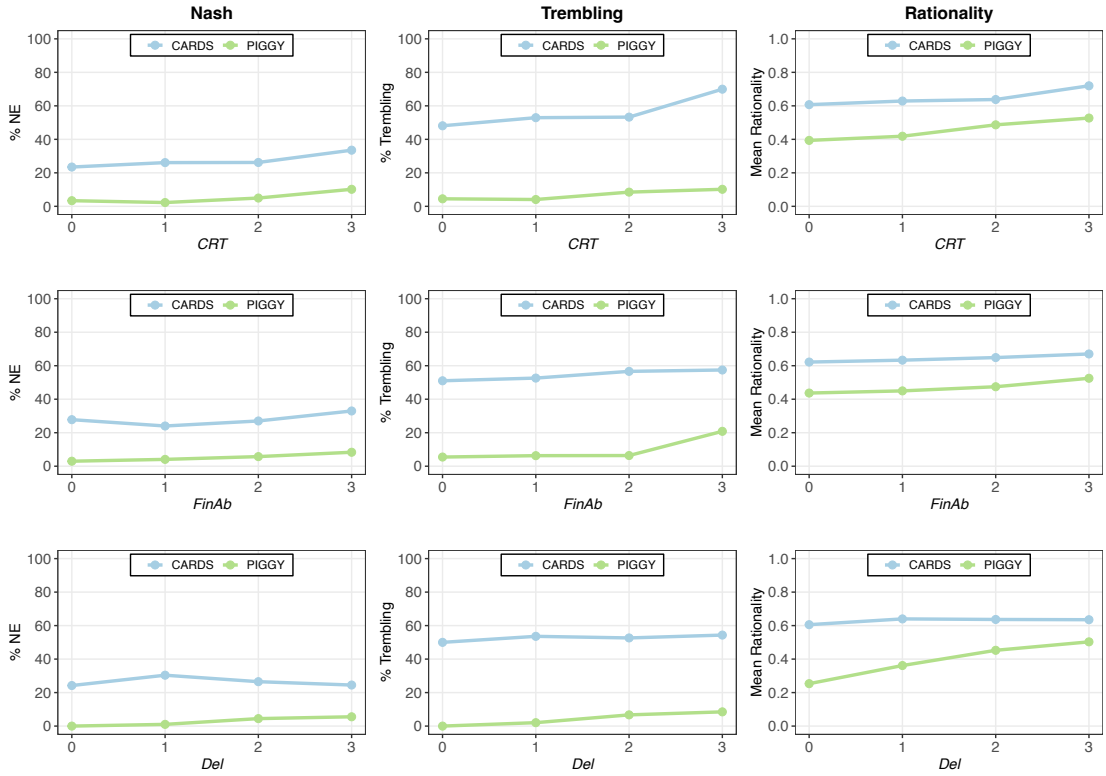
Q3. In a library, the number of books doubles every month. If it takes 48 months for the library to become full, how many months would it take for it to be half full? Indicate with a number. (**Reflective: 47**; Intuitive: 24)

Appendix C

Chapter 5

C.1 Appendix I - Additional statistical analysis

Figure C.1: Strategic performance by *CRT*, *FinAb* and *Del*



Note: Mean strategic performance in *CARDS* (blue) and *PIGGY* (green) as a function of the number of correct answers in *CRT*, *FinAb* and *Del*. The sum of these three components constitutes the synthetic *CogAb* score. Each row corresponds to one of the three cognitive measures. Within each row, the left panel shows the percentage of participants playing *Nash*, *Trembling* and *Rationality*.

Table C.1: Distribution of responses in *CARDS* and *PIGGY*

Card / Seconds	1 / 0-6	2 / 7-12	3 / 13-18	4 / 19-24	5 / 25-30	Total
CARDS	158 (5.8%)	374 (13.8%)	731 (26.9%)	740 (27.2%)	715 (26.3%)	2718
PIGGY	167 (25.6%)	111 (17%)	211 (32.3%)	100 (15.3%)	64 (9.8%)	653

Note: In order to display both experimental designs with the same number of columns, *Secondstopulse* were aggregated in groups of 6.

Table C.2: Distribution of responses in control variables

Variable	0	1	2	3	4	5	6	7	8	9	Total
CRT	430 (12.8%)	1056 (31.4%)	1646 (48.9%)	232 (6.9%)							3364
FinAb	946 (28.3%)	1357 (40.5%)	927 (27.7%)	118 (3.5%)							3348
Del	153 (4.6%)	516 (15.6%)	1212 (36.5%)	1436 (43.3%)							3317
CogAb	28 (0.9%)	102 (3.1%)	217 (6.6%)	423 (12.9%)	615 (18.7%)	755 (22.9%)	641 (19.5%)	356 (10.8%)	125 (3.8%)	29 (0.9%)	3291
Risky	19 (0.6%)	96 (2.8%)	363 (10.8%)	1073 (31.8%)	1409 (41.8%)	347 (10.3%)	62 (1.8%)				3369
Patience	585 (17.4%)	309 (9.2%)	248 (7.4%)	387 (11.5%)	524 (15.6%)	960 (28.5%)	355 (10.5%)				3368

Note: Columns are enumerated by the number of reflective or correct answers in *CRT* or *FinAb*, comprehension in probability in *Del*, total punctuation in *CogAb*, number of risky choices in *Risky* and number future choices in *Patience*.

Table C.3: Determinants of *Nash*, *Trembling* and *Rationality* by *CogAb*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			CARDS							PIGGY		
	Nash	Nash	Trembling	Trembling	Rationality	Rationality	Nash	Nash	Trembling	Trembling	Rationality	Rationality
CogAb_std - CARDS		0.002		0.026***		0.011**						
		(0.861)		(0.008)		(0.028)						
CogAb_std - PIGGY								0.020**		0.022**		0.052***
								(0.023)		(0.029)		(0.000)
Age	-0.007	-0.006	-0.002	-0.004	-0.001	-0.001	-0.009	-0.011	-0.004	-0.006	0.006	0.001
	(0.290)	(0.310)	(0.782)	(0.579)	(0.892)	(0.779)	(0.191)	(0.118)	(0.710)	(0.539)	(0.541)	(0.951)
Female	-0.004	-0.007	0.001	0.005	0.002	0.003	-0.006	-0.002	-0.014	-0.010	0.017	0.028
	(0.827)	(0.690)	(0.943)	(0.802)	(0.864)	(0.771)	(0.704)	(0.905)	(0.495)	(0.643)	(0.426)	(0.162)
Repeater	-0.008	-0.009	-0.044	-0.013	-0.022	-0.010	-0.015	0.004	-0.045*	-0.025	-0.118***	-0.071**
	(0.876)	(0.871)	(0.425)	(0.824)	(0.430)	(0.723)	(0.373)	(0.822)	(0.068)	(0.277)	(0.002)	(0.047)
Class Size	-0.007	-0.007	-0.004	-0.004	-0.003	-0.003	-0.002	-0.002	0.001	0.001	0.002	0.002
	(0.122)	(0.121)	(0.439)	(0.410)	(0.275)	(0.260)	(0.620)	(0.567)	(0.864)	(0.909)	(0.664)	(0.739)
RiskyS	0.053	0.058	-0.003	0.018	-0.001	0.010	-0.051	-0.046	-0.091*	-0.086	-0.044	-0.033
	(0.309)	(0.248)	(0.960)	(0.762)	(0.966)	(0.736)	(0.298)	(0.327)	(0.096)	(0.106)	(0.555)	(0.641)
PatienceS	0.024	0.024	0.065**	0.054**	0.030**	0.025*	0.021	0.019	0.025	0.022	0.051	0.046
	(0.320)	(0.354)	(0.013)	(0.041)	(0.021)	(0.056)	(0.346)	(0.381)	(0.348)	(0.377)	(0.147)	(0.191)
Second Position							-0.009	-0.009	-0.006	-0.007	-0.009	-0.010
							(0.620)	(0.601)	(0.753)	(0.733)	(0.590)	(0.529)
Constant	0.548***	0.544***	0.627***	0.651***	0.786***	0.791***	0.286**	0.313**	0.270*	0.298*	0.317*	0.386**
	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.027)	(0.018)	(0.089)	(0.065)	(0.091)	(0.040)
R-squared	0.009	0.010	0.012	0.015	0.010	0.011	0.095	0.104	0.108	0.115	0.036	0.069
N	2,715	2,636	2,715	2,636	2,715	2,636	646	646	646	646	646	646

Robust pval in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: Estimation of the impact of cognitive abilities in optimizing *CARDS* and *PIGGY* through linear regressions. For all models we regress the effect of different control variables respect to outcomes (*Nash*, *Trembling* and *Rationality*) while we added for a second specification of each model the effect of the age-adjusted cognitive ability index in standard deviation units for each experimental design subsample. Control variables include age of participants and gender (*Female*), the standardized measures of risk attitudes (*RiskyS*) and patience (*PatienceS*), if they had to enroll at least twice in the same school year because they failed (*Repeater*) and the class size. Also, to control potential order effects in *PIGGY*, we include the variable *SecondPosition*, which indicates whether *PIGGY* design question was presented in second position of the design. This variable is included only in the regressions related to *PIGGY*. All specifications also include school fixed effects, and all regressions are estimated using heteroskedasticity-robust standard errors clustered at the class level.

Table C.4: Determinants of *Nash*, *Trembling* and *Rationality* in *CARDS* by *CRT*, *FinAb* and *Del*

	CARDS														
	(1) Nash	(2) Nash	(3) Nash	(4) Nash	(5) Nash	(6) Trembling	(7) Trembling	(8) Trembling	(9) Trembling	(10) Trembling	(11) Rationality	(12) Rationality	(13) Rationality	(14) Rationality	(15) Rationality
CRT		0.019*			0.021*		0.036***			0.030**		0.017***			0.015**
		(0.095)			(0.068)		(0.004)			(0.026)		(0.007)			(0.020)
FinAb			0.005		0.002			0.025**		0.016			0.010*		0.006
			(0.645)		(0.884)			(0.034)		(0.194)			(0.066)		(0.281)
Del				-0.015	-0.017*				0.008	0.002				0.001	-0.002
				(0.133)	(0.092)				(0.473)	(0.891)				(0.838)	(0.736)
Age	-0.007	-0.008	-0.008	-0.005	-0.007	-0.002	-0.005	-0.006	-0.003	-0.008	-0.001	-0.002	-0.002	-0.001	-0.003
	(0.290)	(0.195)	(0.255)	(0.413)	(0.278)	(0.782)	(0.476)	(0.398)	(0.680)	(0.262)	(0.892)	(0.584)	(0.550)	(0.890)	(0.463)
Female	-0.004	-0.005	-0.005	-0.007	-0.008	0.001	0.002	0.008	-0.000	0.005	0.002	0.001	0.004	0.001	0.002
	(0.827)	(0.802)	(0.786)	(0.705)	(0.657)	(0.943)	(0.932)	(0.699)	(0.993)	(0.825)	(0.864)	(0.887)	(0.661)	(0.926)	(0.805)
Repeater	-0.008	0.004	-0.012	-0.010	-0.006	-0.044	-0.020	-0.029	-0.033	-0.010	-0.022	-0.010	-0.015	-0.019	-0.009
	(0.876)	(0.940)	(0.831)	(0.856)	(0.914)	(0.425)	(0.722)	(0.620)	(0.548)	(0.856)	(0.430)	(0.738)	(0.600)	(0.485)	(0.756)
Class size	-0.007	-0.007	-0.007	-0.007	-0.007	-0.004	-0.004	-0.003	-0.004	-0.004	-0.003	-0.003	-0.003	-0.003	-0.003
	(0.122)	(0.114)	(0.113)	(0.152)	(0.130)	(0.439)	(0.406)	(0.485)	(0.404)	(0.420)	(0.275)	(0.250)	(0.291)	(0.275)	(0.269)
RiskyS	0.053	0.058	0.065	0.049	0.061	-0.003	0.006	0.011	0.003	0.020	-0.001	0.003	0.006	0.003	0.011
	(0.309)	(0.262)	(0.207)	(0.332)	(0.221)	(0.960)	(0.922)	(0.855)	(0.959)	(0.731)	(0.966)	(0.917)	(0.844)	(0.930)	(0.698)
PatienceS	0.024	0.019	0.026	0.026	0.022	0.065**	0.054**	0.057**	0.065**	0.052**	0.030**	0.025*	0.027**	0.031**	0.024*
	(0.320)	(0.448)	(0.303)	(0.295)	(0.407)	(0.013)	(0.039)	(0.028)	(0.013)	(0.050)	(0.021)	(0.059)	(0.035)	(0.020)	(0.070)
Constant	0.548***	0.540***	0.549***	0.555***	0.555***	0.627***	0.618***	0.629***	0.629***	0.632***	0.786***	0.782***	0.789***	0.782***	0.784***
	(0.000)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-squared	0.009	0.010	0.010	0.010	0.012	0.012	0.015	0.014	0.012	0.016	0.010	0.013	0.011	0.009	0.013
N	2,715	2,709	2,693	2,661	2,636	2,715	2,709	2,693	2,661	2,636	2,715	2,709	2,693	2,661	2,636

Robust pval in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: Estimation of the impact of *CRT*, *FinAb* and *Del* in optimizing *CARDS* through linear regressions. For all models we regress the effect of different control variables respect to outcomes (*Nash*, *Trembling* and *Rationality*) while we added for a second, third and fourth specification of each model the effect of each variable that composes *CogAb*. In fifth specification we added all these three components. Control variables include age of participants and gender (*Female*), the standardized measures of risk attitudes (*RiskyS*) and patience (*PatienceS*), if they had to enroll at least twice in the same school year because they failed (*Repeater*) and the class size. All specifications also include school fixed effects, and all regressions are estimated using heteroskedasticity-robust standard errors clustered at the class level.

Table C.5: Determinants of *Nash*, *Trembling* and *Rationality* in *PIGGY* by *CRT*, *FinAb* and *Del*

	PIGGY														
	(1) Nash	(2) Nash	(3) Nash	(4) Nash	(5) Nash	(6) Trembling	(7) Trembling	(8) Trembling	(9) Trembling	(10) Trembling	(11) Rationality	(12) Rationality	(13) Rationality	(14) Rationality	(15) Rationality
CRT		0.020*			0.015		0.020*			0.014		0.041***			0.028**
		(0.059)			(0.149)		(0.081)			(0.241)		(0.003)			(0.039)
FinAb			0.016*		0.010			0.014		0.008			0.015		-0.003
			(0.080)		(0.235)			(0.248)		(0.536)			(0.201)		(0.829)
Del				0.014*	0.009				0.019**	0.015*				0.067***	0.062***
				(0.054)	(0.162)				(0.032)	(0.082)				(0.000)	(0.000)
Age	-0.009	-0.011	-0.012	-0.010	-0.013*	-0.004	-0.005	-0.006	-0.005	-0.007	0.006	0.002	0.003	0.003	0.001
	(0.191)	(0.137)	(0.105)	(0.163)	(0.093)	(0.710)	(0.599)	(0.510)	(0.642)	(0.465)	(0.541)	(0.775)	(0.746)	(0.731)	(0.872)
Female	-0.006	-0.004	-0.003	-0.006	-0.002	-0.014	-0.012	-0.011	-0.014	-0.010	0.017	0.022	0.020	0.016	0.020
	(0.704)	(0.832)	(0.879)	(0.704)	(0.912)	(0.495)	(0.584)	(0.601)	(0.494)	(0.620)	(0.426)	(0.259)	(0.331)	(0.414)	(0.311)
Repeater	-0.015	-0.003	-0.005	-0.009	0.004	-0.045*	-0.033	-0.036	-0.036	-0.025	-0.118***	-0.094**	-0.109***	-0.090**	-0.077**
	(0.373)	(0.849)	(0.763)	(0.586)	(0.816)	(0.068)	(0.173)	(0.135)	(0.108)	(0.271)	(0.002)	(0.011)	(0.004)	(0.013)	(0.026)
Class size	-0.002	-0.002	-0.002	-0.002	-0.002	0.001	0.000	0.001	0.001	0.001	0.002	0.001	0.002	0.003	0.002
	(0.620)	(0.506)	(0.626)	(0.636)	(0.548)	(0.864)	(0.966)	(0.860)	(0.836)	(0.913)	(0.664)	(0.841)	(0.661)	(0.557)	(0.687)
RiskyS	-0.051	-0.047	-0.047	-0.051	-0.046	-0.091*	-0.088	-0.087	-0.091*	-0.087	-0.044	-0.037	-0.040	-0.046	-0.041
	(0.298)	(0.312)	(0.328)	(0.296)	(0.328)	(0.096)	(0.101)	(0.106)	(0.096)	(0.105)	(0.555)	(0.595)	(0.584)	(0.547)	(0.567)
PatienceS	0.021	0.019	0.021	0.021	0.019	0.025	0.022	0.024	0.024	0.022	0.051	0.046	0.051	0.051	0.047
	(0.346)	(0.410)	(0.351)	(0.341)	(0.395)	(0.348)	(0.397)	(0.353)	(0.338)	(0.378)	(0.147)	(0.212)	(0.150)	(0.134)	(0.181)
Second position	-0.009	-0.008	-0.010	-0.008	-0.009	-0.006	-0.006	-0.007	-0.006	-0.006	-0.009	-0.008	-0.010	-0.008	-0.008
	(0.620)	(0.641)	(0.572)	(0.624)	(0.603)	(0.753)	(0.773)	(0.710)	(0.757)	(0.744)	(0.590)	(0.630)	(0.541)	(0.602)	(0.632)
Constant	0.286**	0.290**	0.302**	0.258**	0.280**	0.270*	0.273*	0.284*	0.231	0.250	0.317*	0.325*	0.333*	0.181	0.195
	(0.027)	(0.025)	(0.023)	(0.040)	(0.030)	(0.089)	(0.085)	(0.082)	(0.131)	(0.111)	(0.091)	(0.073)	(0.086)	(0.304)	(0.262)
R-squared	0.095	0.101	0.099	0.098	0.104	0.108	0.112	0.110	0.112	0.115	0.036	0.051	0.038	0.078	0.084
N	646	646	646	646	646	646	646	646	646	646	646	646	646	646	646

Robust pval in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: Estimation of the impact of *CRT*, *FinAb* and *Del* in optimizing *CARDS* through linear regressions. For all models we regress the effect of different control variables respect to outcomes (*Nash*, *Trembling* and *Rationality*) while we added for a second, third and fourth specification of each model the effect of each variable that composes *CogAb*. In fifth specification we added all these three components. Control variables include age of participants and gender (*Female*), the standardized measures of risk attitudes (*RiskyS*) and patience (*PatienceS*), the class size and school type (*Public*) and the device used to complete the survey (*Phone* and *Tablet*). Also, to control potential order effects in *PIGGY*, we include the variable *SecondPosition*, which indicates whether *PIGGY* design question was presented in second position of the design. All specifications also include school fixed effects, and all regressions are estimated using heteroskedasticity-robust standard errors clustered at the class level.

Table C.6: Determinants of *Secondstopulse* in *PIGGY*

	(1) Seconds no FE	(2) Seconds FE School	(3) Seconds FE Class	(4) Seconds no FE	(5) Seconds FE School	(6) Seconds FE Class	(7) Seconds no FE	(8) Seconds FE School	(9) Seconds FE Class
Computer	-1.908	-2.024	-1.076						
	(0.581)	(0.586)	(0.722)						
Tablet				1.845*	1.630	1.518			
				(0.084)	(0.125)	(0.185)			
Phone							-1.729	-1.518	-1.446
							(0.100)	(0.150)	(0.196)
Constant	13.658***	13.345***	7.083***	13.290***	12.915***	6.957***	15.031***	14.427***	8.408***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
R-squared	0.000	0.007	0.079	0.008	0.013	0.083	0.007	0.012	0.083
N	653	653	653	653	653	653	653	653	653

Robust pval in parentheses *** p<0.01, ** p<0.05, * p<0.1

Note: Estimation of the impact of time of response in *PIGGY* through linear regressions. For each models we regress the effect of *Secondstopulse* for each device including no fixed effects (models 1, 4 and 7), school fixed effects (models 2, 5 and 8) and class fixed effects (models 3, 6 and 9). All specifications are estimated using heteroskedasticity-robust standard errors clustered at the class level.

C.2 Appendix II - Supplementary Materials

C.2.1 *Games' Screenshots*

Box 1 - *CARDS* experimental design

Screen 1:

You are now going to be **paired** with another participant, but you will **NOT know** who they are.

Both of you see the same cards. And each of you **choose one**, at the same time and without speaking.

- If both of you choose the **same card**, YOU get **the number of points shown on that card** and THE OTHER PERSON gets **0 points**.
- If you do **NOT** choose the **same card**, EACH OF YOU gets **the number of points shown on your chosen card**.

Which card do you choose?

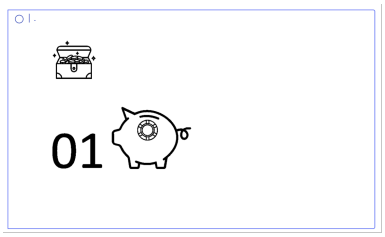
- 1
- 2
- 3
- 4
- 5

Box 2 - *PIGGY* experimental design

Screen 1:

You are now going to be paired with another participant, but you will not know who they are. The other person will not know who you are either.

Imagine a **piggy bank** like the one below that receives one euro every second for **30 seconds**. For example: after one second it will contain €1, after two seconds €2, and so on until it reaches €30, after which it will be destroyed.



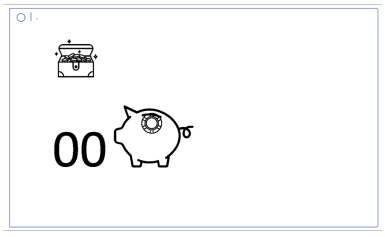
Screen 2:

In this case, the money will go to the person who presses the piggy bank **SECONDLY**, keeping the **euros** it contains at that moment. You can press anywhere on the piggy bank to stop it. Remember:

- If you are the second participant to press, you will earn the number of euros in the piggy bank at that moment.
- If you are the first participant to press, or if you do not press within 30 seconds, you earn 0 euros.
- If both of you press at the same time, it's a tie and the euros in the piggy bank will be split equally between you.

Screen 3:

The piggy bank goes to the SECONDLY person to press it, with the euros it contains at that moment.



C.2.2 *CognitiveReflectionTest(CRT)*

The items used in the *CRT* task are shown in Figure C.2. Reflective and intuitive answers are shown in parentheses. The order of the items was randomized.

Figure C.2: *CRT* questions

Q1. Emilia's father has three daughters. The first two are named April and May. What is the name of the third daughter?

(**Reflective: Emilia**; Intuitive: June)

Q2. If you are running a race and you overtake the person in second place, what position are you in? Indicate with a number. For example: 1 (first), 2 (second), etc.

(**Reflective: 2**; Intuitive: 1)

Q3. In a library, the number of books doubles every month. If it takes 48 months for the library to become full, how many months would it take for it to be half full? Indicate with a number.

(**Reflective: 47**; Intuitive: 24)

C.2.3 *FinancialAbilities*

The items used in the *FinAb* task are shown in Figure C.3. Correct answers are shown in parentheses or in bold. The order of the items was randomized.

Figure C.3: *FinAb* questions

Q1. If there are 5 people who own the winning lottery ticket and the prize to be shared is 2 million euros, how much money will each person receive? Write the amount using numbers only, without dots or commas.

(**Correct answer: 400,000)**

Q2. Imagine you have €100 in a savings account. The account earns an interest rate of 10% per year. How much money will you have in the account after 2 years?

(**Correct answer: 121)**

Q3. Imagine you have €100 in a savings account and the interest rate you earn is 2% per year. If you keep the money in the account for 5 years, how much money will you have at the end of those 5 years?

- Less than 102€
- 102€ exactly
- **More than 102€**
- I don't know

C.2.4 *DelavandeTest*

A violation of the Delavande test occurs when:

- The value reported for the first question is lower than that reported for the second.

- The value reported for the third question is lower than that reported for the fourth.

- The value reported for the fifth question is lower than that reported for the sixth.

Note that participants in the first 10 schools responded to the task by entering a number, while in the rest 2 schools of the sample a half of participants entered numbers and the other half moved a slider with randomization at the individual level (see Figure C.4). The instructions and questions were maintained in both versions.

Figure C.4: Slider

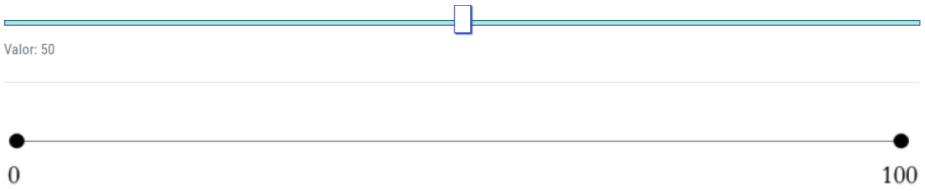


Figure C.5: *Del* - Screen 1

In the next screen, we **will ask you** about the **probability** that certain things could happen. In each question, you should **write down** how **likely you think** it is that these things will happen in reality.

If you think something will happen for **sure**, you should write **100**. If you are fairly but not completely sure, write a number close to 100 (but less than 100). If you think it is something that will **never** happen, write **0**. If you think it is unlikely, write a number close to 0 (but greater than 0). If you think it is **equally likely** to happen or not to happen, write **50**.

Figure C.6: *Del* - Screen 2

EXAMPLES:

- If it is a sunny day and I ask you how likely it is that it will be sunny within 1 hour, you would typically say 100 or numbers very close to 100.
- If it is 12 o'clock at night, the most reasonable thing to say is that the probability that it will be sunny in 1 hour is 0.
- If I flip a coin, the probability that it will come up heads is 50.

Figure C.7: *Del* questions

Q1. Imagine that I have a basket with 5 apples: 1 green and 4 red. If I ask you to choose one of the apples without looking inside the basket, how likely is it that you pick the green apple, from 0 to 100?

Q2. Imagine that I have a basket with 10 apples: 1 green and 9 red. If I ask you to choose one of the apples without looking inside the basket, how likely is it that you pick the green apple, from 0 to 100?

Q3. How likely is it that you eat rice in the next week from 0 to 100? (Including today)

Q4. How likely is it that you eat rice in the next month from 0 to 100? (Including today)

Q5. How likely is it that you do not attend your educational center even once in the next month from 0 to 100? (Including today)

Q6. How likely is it that you take a shower at least once during the next month from 0 to 100? (Including today)

C.2.5 *TheTrukTask*

Figure C.8: *TheTrukTask* - Screen 1

Throughout the next 6 screens, you will have to make 6 decisions (one per screen) about **how you want to receive a hypothetical amount of money.** Your task is to choose which option you prefer, knowing that if you choose one you will receive the money **tomorrow**, and if you choose the other you will receive it **next week**. As you progress through the decisions, the amount of money you will receive for waiting will get **larger and larger**.

Figure C.9: *TheTrukTask* - Screen 2

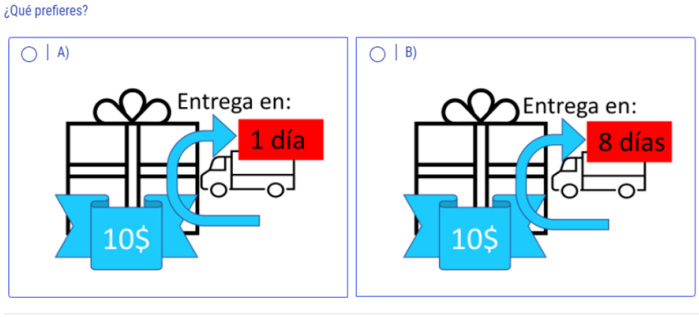


Figure C.10: *TheTrukTask* - Screen 3

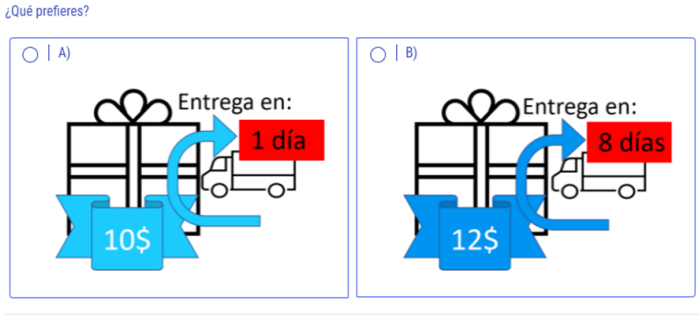


Figure C.11: *TheTrukTask* - Screen 4

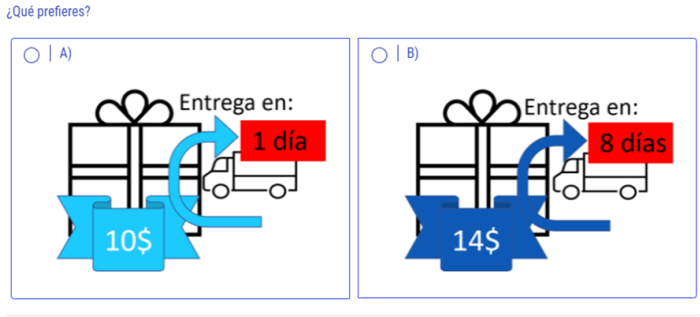


Figure C.12: *TheTrukTask* - Screen 5

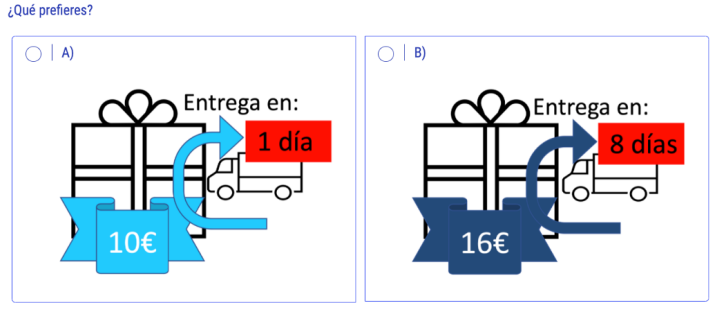


Figure C.13: *TheTrukTask* - Screen 6

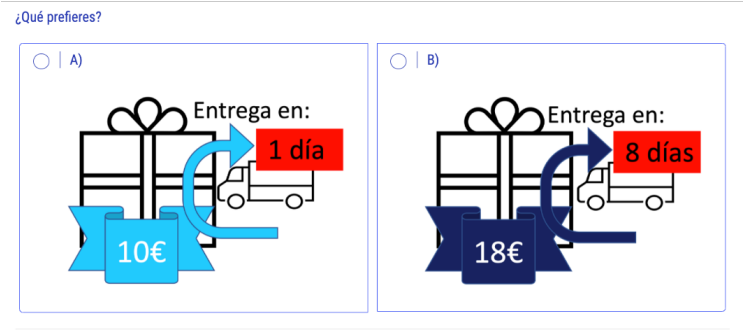


Figure C.14: *TheTrukTask* - Screen 7

C.2.6 *TheGumballMachine*

Figure C.15: *TheGumballMachine* - Screen 1

In this task you are going to make decisions about **probabilities**. Probability is the possibility of something happening, that is, how someone is sure what is going to happen.

In each decision **you will have to choose between two options** where you can win fictitious money: in both you will win, but you can be luckier and win more, or you can be less lucky and win less. **The probabilities of winning change** from one decision to another.

Below, you are presented with **6 different questions**. Your task is to choose option **A)** or option **B)** in all questions.

To complete the task, proceed to the **next screen**.

Figure C.16: *TheGumballMachine* - Screen 2

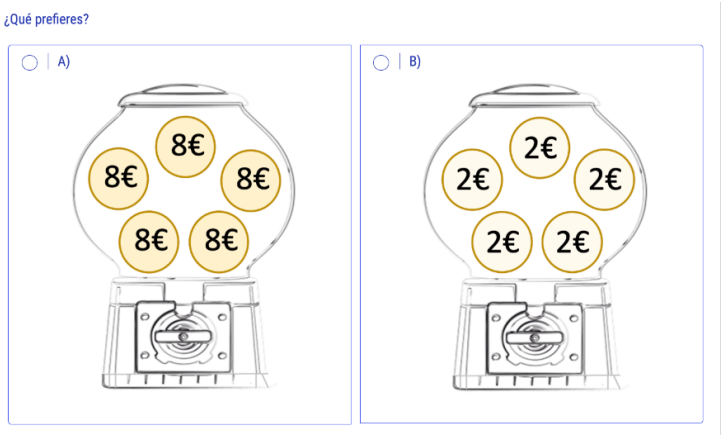


Figure C.17: *TheGumballMachine* - Screen 3

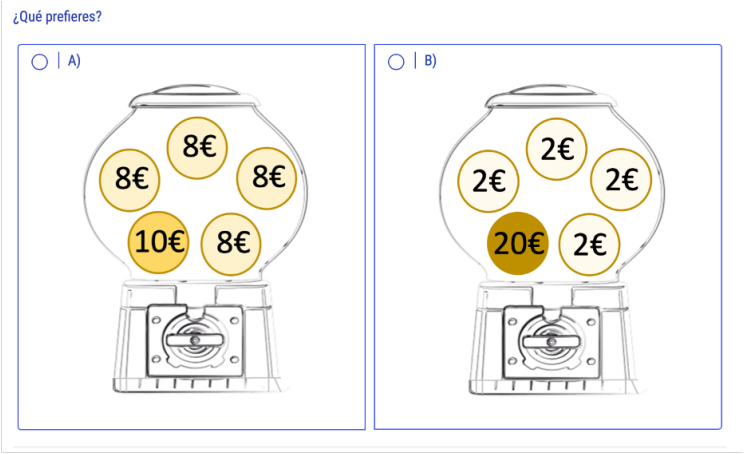


Figure C.18: *TheGumballMachine* - Screen 4

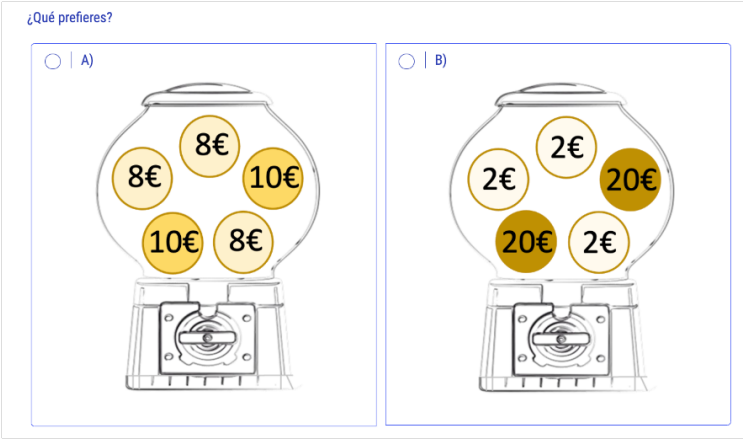


Figure C.19: *TheGumballMachine* - Screen 5

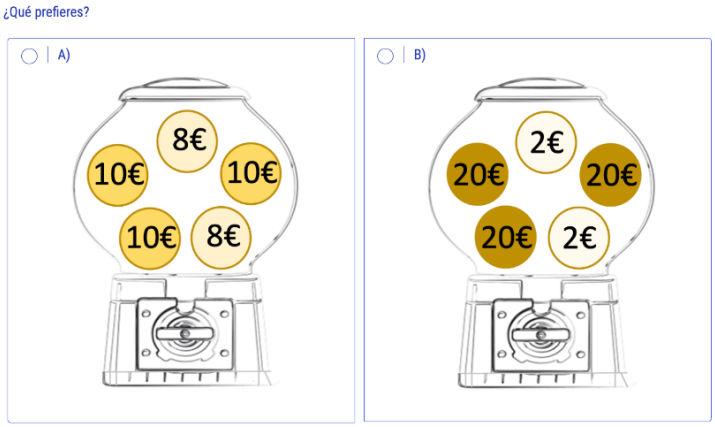


Figure C.20: *TheGumballMachine* - Screen 6

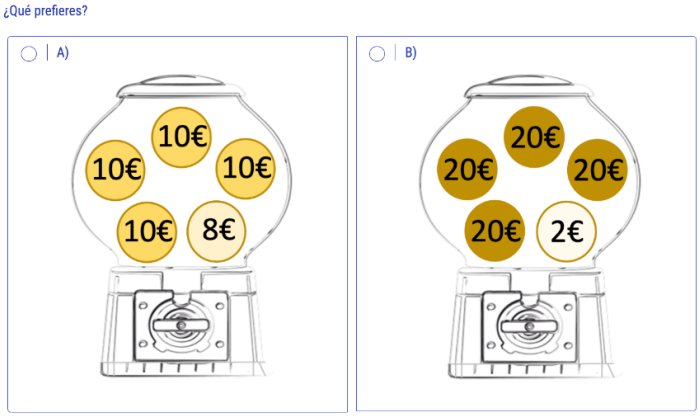
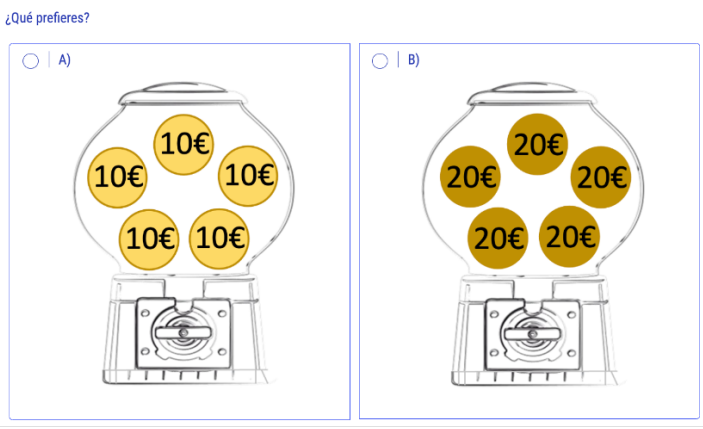


Figure C.21: *TheGumballMachine* - Screen 7



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Appendix D

Documentación adicional

1. Artículo JCR
2. Certificados de congresos internacionales
3. Aprobación de la investigación por el Comité de Ética
4. Documentos justificativos de mención internacional
5. Participación en proyecto de investigación

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DATA DESCRIPTOR

Economic preferences and cognitive abilities among teenagers in Spain

Mónica Vasco[1]✉, Antonio Alfonso[1], Andreu Arenas[2], Antonio Cabrales[3], José A. Cuesta[4], Antonio M. Espín[5], María Paz Espinosa[6], Teresa García-Muñoz[7], Àlex Izquierdo Nofuentes[2], Diego Jorrat[1], Jaromír Kovářík[6,8], Pablo Lomas[1], Alfonso Carlos Martínez-Estudillo[1], Daniel Montolio[2], María del Pino Ramos-Sosa[1], Patricia Román[1], Ángel Sánchez[4], María José Vázquez-De Francisco[1,9] & Pablo Brañas-Garza[1]

This dataset originates from *TeensLab*, a consortium of Spanish Universities dedicated to behavioral research involving Spanish teenagers. The dataset contains data from 33 distinct educational institutions across Spain, accounting for a total of 5,890 students aged 10 to 23 (M = 14.10, SD = 1.94), representing various educational levels such as primary school, secondary school, sixth form and vocational training. The main dimensions covered in this dataset include (*i*) economic preferences, (*ii*) cognitive abilities and (*iii*) strategic thinking. Additionally, a range of supplementary variables is included alongside socio-demographic factors, capturing data on aspects like physical appearance, mood and expectations, among others.

Background & Summary

Adolescence is a stage of major physical, psychological, emotional and social development, representing a crucial period in human life. The experiences, skills and habits that are accumulated during this stage have a permanent impact on human life. Therefore, understanding the behavior of individuals throughout this period is essential to supporting their development and ensuring their success in adulthood. Indeed, there is great interest in underlying motivations of adolescent behaviors for the design of public policies[1].

It is widely recognized that individual preferences and cognitive abilities are important determinants of real-life decision-making of adults in strategic and non-strategic situations[2–6]. To understand and predict adult behavior, it is essential to comprehend how their attitudes toward risk, social and time preferences, cognitive abilities, creativity, and other traits evolve, particularly in their younger years[7–18].

The dataset presented here contributes to the literature on adolescence by eliciting-using the tools of experimental economics-rich information on economic preferences, cognitive abilities, strategic thinking behavior and other information from a large set of adolescents in Spain. We conducted lab-in-the-field experiments in 33 different educational centers, accounting for a total of 5,890 observations of Spanish students. The centers belong to 19 different locations. A total of 20 of them are public and the rest are semi-private. In addition to socio-demographic details and other variables related to the individual, the data includes several sets of variables: economic preferences, cognitive abilities, strategic thinking and other additional measures.

Our dataset can contribute to future research on adolescents in at least two ways. First, it allows researchers to study adolescent decision-making and understand developmental causes of anomalous behavior. Second, it provides information on economic preferences, cognitive skills and other individual information, enabling exploring the extent to which these variables are sensitive to the class and school environment.

This dataset has been previously employed in the following studies: (*i*) An analysis of the relevance of monetary incentives, experimental tools and protocols to collect data in schools[19], (*ii*) a study of the impact of visual aids in experimental lottery tasks to reduce inconsistency among adolescents[20], (*iii*) the development of time and risk preferences throughout the adolescence[21], (*iv*) the dynamics of social preferences among girls and boys[22]

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2. Certificados de congresos internacionales

V AJICEDE

La comunicación titulada:

The adventure of running experiments with teenagers (Alfonsto-Costillo A., Brañas-Garza P., Jorrat D., Lomas P., Prissé B., Vasco M. and Vázquez-De Francisco M.J., 2022 Mimeo)

Pablo Montero Lomas

Ha sido presentada en el marco del **V Congreso Iberoamericano de Jóvenes Investigadores en Ciencias Económicas y Dirección de Empresas**, celebrado en Córdoba del 14 al 16 de diciembre de 2022.

Y para que así conste, se expide la siguiente certificación a 15 de diciembre de 2022.

Fdo.: María del Mar Ortiz Gómez	Fdo.: Laura Serrano Mendoza	Fdo.: Elena Moreno Ureba
Co-Chair del Congreso	Co-Chair del Congreso	Secretaria General de AJICEDE

I undersigned, Agnès Festré, scientific coordinator of the IAREP-SABE Conference held in Nice, 7-10 June 2023, certify that

Pablo Lomas

Participated at the conference, presenting the research work:

The more...the better? The causal effect of the number of siblings on cognitives and social preferences: evidence from adolescents

Professeur Agnès Festré,

Université Côte d'Azur

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University of Exeter Business School

EUROPEAN ESA MEETING 2023 | EXETER

European Economic Science Association Conference 2023 | Exeter

Conference Certificate of Attendance

Conference dates:	11th September – 13th September 2023.
Attendee:	**Pablo Montero Lomas**
	Universidad Loyola Andalucía
Presentation:	**Payoff Dominance Is More Natural Than Risk Dominance**
Location:	Matrix Lecture Theatre, Building One
	2023-09-12 10:30 – 12:00
	A2: Co-Ordination Games

Many thanks.

_____

Brit Grosskopf

Professor of Economics
Head of the Organizing Committee
University of Exeter Business School
Rennes Dr, Exeter EX4 4PU, United Kingdom
Email: B.Grosskopf@exeter.ac.uk

economic science association

Exeter 2023

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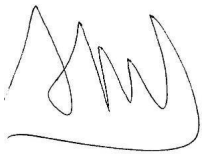
PROOF OF ATTENDANCE

This certificate is presented to

Pablo Montero Lomas

For attending the **"Workshop on Market, Cooperation and Votes"**
hosted by Universidad Carlos III de Madrid
The conference took place on 13-14 June 2024.

Work presented: "Developmental equilibrium selection"



Antonio Cabrales
Organizing committee

Certificate of presentation

I hereby certify that **Pablo Lomas**
(Universidad Loyola Andalucía)

has presented the paper: *"The weight of cognitive abilities: Testing and re-testing strategic games in adolescents"*

for the Southern Europe Experimental Team's Meeting 2026 (SEET 2026), ***11-13 March, Sevilla, Spain***

Natalia Jiménez Jiménez

Chief-organizer SEET 2026

3. Aprobación de la investigación por el Comité de Ética

El Comité de Ética de la Universidad Loyola Andalucía ha emitido valoración relativa al proyecto *Mapeo de las competencias y habilidades sociales en el alumnado* remitido por la Sra. Maria José Vázquez para su valoración ética.

El Comité de Ética de la Universidad Loyola Andalucía ha valorado, por unanimidad, que el proyecto cumple con los criterios éticos necesarios para su desarrollo.

Empero, este comité sugiere que se valore la posibilidad de simplificar expresiones complejas tales como "aversión al riesgo" por otras quizá más entendibles para su audiencia.

Adicionalmente, falta la hoja informativa para los alumnos que son mayores de 16, porque son hojas distintas, ya que los menores de 14 contestan a los padres.

Por otra parte, examinada la documentación parece que se ha hecho ya un pilotaje y se desconoce si ha pasado por el Comité y cuenta con su aprobación, por lo que se solicita el informe en tal caso.

Resolución: **INFORME FAVORABLE**

Sevilla, 09 de julio de 2020

El Secretario

TAPIA FRADE, ALEJANDRO JOSE (AUTENTICACIÓN)

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Fdo. Alejandro Tapia Frade

El Comité de Ética de la Universidad Loyola Andalucía ha emitido valoración relativa al Proyecto *Estudio de competencias y habilidades sociales del alumnado de origen migrante en educación secundaria que informen sobre desigualdades y brecha educativa causadas por el covid19* remitido por el investigador Lorenzo Estepa Mohedano para su valoración ética.

El Comité de Ética de la Universidad Loyola Andalucía ha valorado, por unanimidad, que el proyecto cumple con los criterios éticos necesarios para su desarrollo.

Resolución: **INFORME FAVORABLE**

Sevilla, 16 de diciembre de 2021

Vº Bº El Presidente

SEPULVEDA DEL RÍO, JUAN IGNACIO (AUTENTICACIÓN)

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Fdo. Ignacio Sepúlveda del Río

UNIVERSITAT DE BARCELONA

Comissió de Bioètica
Universitat de Barcelona

Dictamen favorable

La Comissió de Bioètica de la Universitat de Barcelona (CBUB), reunida en sessió ordinària del dia 26 d'octubre de 2022, va avaluar els aspectes metodològics, ètics i legals de la tesi doctoral "Essays on Decision Making" del doctorand Àlex Izquierdo Nofuentes, dirigida per el Dr. Andreu Arenas Jal i el Dr. Daniel Montolio Estivill i adscrita al programa de Doctorat en Economia de la Facultat d'Economia i Empresa, Departament d'Economia, Secció d'Economia Pública, Economia Política i Economia Espanyola, UB. La CBUB va efectuar observacions que havien de ser incloses en el projecte per a poder emetre dictamen favorable. El doctorand va enviar la informació requerida el 2 de novembre de 2022, que ha estat avaluada per la Secretaria de la CBUB, obtenint dictamen favorable.

En Barcelona, a 2 de novembre de 2022.

JORDI GARCIA FERNANDEZ - DNI 35030054L (TCAT)

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Fecha: 2022.11.03 07:10:05 +01'00'

Dr. Jordi García Fernández
Vicerector de Recerca
President de la Comissió de Bioètica
Universitat de Barcelona

Institutional Review Board (IRB00003099)

Universidad LOYOLA

Teniendo en consideración la documentación presentada por el Sr. Pablo Brañas Garza, en relación con la investigación titulada *"Mapeo de las competencias y habilidades sociales en el alumnado"*,

Se resuelve acoger el informe favorable del Institutional Review Board de la University of Southern California (unidad dependiente de la Oficina para la Protección de los Sujetos de Investigación (OPRS), brazo administrativo del Programa de Protección de la Investigación Humana (HRPP) de la USC) , concedido el 23 de abril de 2019, incluido en la documentación enviada.

Sevilla, 01 de marzo de 2023

Vº Bº Presidente

SEPULVEDA DEL RÍO, JUAN IGNACIO (FIRMA)

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Fdo. Ignacio Sepúlveda Del Río

Vº Bº Secretaria

SERRANO MENDOZA LAURA - 28812846X

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Fdo. Laura Serrano Mendoza

4. Documentos justificativos de mención internacional

SAPIENZA
UNIVERSITÀ DI ROMA

Rome, December 15 2025

Invitation of Pablo Montero Lomas for a Visiting Period at Sapienza University of Rome

To Whom It May Concern

I thereby invite Pablo Montero Lomas (Loyola University Andalucia) to spend a visiting period at the CIMEO (Centre for Investigation and Modelling of Experimental Observations), Department of Economics and Law, Sapienza University of Rome, via del Castro Laurenziano 9, 00161 Rome.

The scheduled visiting period goes from January 15, 2026 to April 15, 2026, with possible extension.

During this time span: we will jointly work on the PRIN project "The impact of past experience and of social identity on risk perception of (new) unforeseen contingencies", of which I am the Principal Investigator at the Sapienza hub; he will give two seminars at the PhD of Socio-Economic and Statistical Studies, of which I am the Coordinator, with one seminar scheduled at the beginning and another at the end of his visiting period.

Please do not hesitate to contact me if I can provide any further information.

Yours Faithfully,

Giuseppe Attanasi

Professor, Sapienza University of Rome
Coordinator, European PhD in Socio-Economic and Statistical Studies
Director, Sapienza Laboratory of Experimental Economics (CIMEO)
President, Society for the Advancement of Behavioral Economics (SABE)
Editor-in-Chief, Journal of Behavioral Economics for Policy (JBEP)
Associate Editor, Journal of Behavioral and Experimental Economics (JBEE)

Rome, December 15 2025

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Professor, Sapienza University of Rome
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Director, Sapienza Laboratory of Experimental Economics (CIMEO)
President, Society for the Advancement of Behavioral Economics (SABE)
Editor-in-Chief, Journal of Behavioral Economics for Policy (JBEP)
Associate Editor, Journal of Behavioral and Experimental Economics (JBEE)

CERTIFICADO DE ESTANCIA DE INVESTIGACIÓN /

CERTIFICATE OF RESEARCH STAY

Sapienza Università di Roma
Dipartimento di Economia e Diritto
Via del Castro Laurenziano, 9
00161 Roma (Italia)

CERTIFICA / CERTIFIES

Que el doctorando D. Pablo Montero Lomas, con DNI 32087470-D matriculado en el programa de Doctorado en Ciencias de los Datos, ha realizado una estancia de investigación en la Sapienza Università di Roma, bajo la supervisión del Prof. Giuseppe Attanasi, en el Department of Economics and Law (CIMEO – Sapienza Experimental Economics Lab).

That the PhD candidate Mr. Pablo Montero Lomas, with identification number 32087470-D, enrolled in the PhD Programme in Data Science, has carried out a research stay at Sapienza University of Rome, under the supervision of Prof. Giuseppe Attanasi, at the Department of Economics and Law (CIMEO – Sapienza Experimental Economics Lab).

PERIODO DE LA ESTANCIA / STAY PERIOD

- **Fecha de inicio / Start date:** January 15, 2026
- **Fecha de finalización / End date:** April 15, 2026

Durante dicho periodo, el doctorando ha llevado a cabo actividades de investigación relacionadas con su tesis doctoral en el ámbito de la economía experimental y del comportamiento, participando activamente en las actividades académicas y científicas del grupo de investigación.

En particular, durante la estancia se han desarrollado las siguientes actividades:

a) Discusión y mejora de los artículos que componen la tesis doctoral, recibiendo retroalimentación especializada sobre diseño experimental, interpretación de resultados y preparación para su publicación en revistas internacionales.

b) Perfeccionamiento del diseño experimental y de la metodología de laboratorio, reforzando la robustez de los resultados y explorando posibles extensiones del proyecto de investigación.

c) Integración y discusión de los resultados de la tesis en el contexto de la literatura científica internacional, fortaleciendo la contribución académica del trabajo.

d) Participación en seminarios, workshops y reuniones del grupo de investigación, facilitando la difusión del trabajo y la obtención de comentarios de investigadores especializados.

e) Desarrollo de colaboraciones internacionales y establecimiento de bases para futuros proyectos de investigación conjuntos.

During this period, the PhD candidate carried out research activities related to his doctoral thesis in the field of experimental and behavioral economics, actively participating in the academic and scientific activities of the research group.

In particular, the following activities were carried out:

a) Discussion and improvement of the articles composing the doctoral thesis, receiving specialized feedback on experimental design, results interpretation, and preparation for publication in international journals.

b) Improvement of experimental design and laboratory methodology, strengthening the robustness of results and exploring possible extensions of the research project.

c) Integration and discussion of the thesis results within the international scientific literature, enhancing the academic contribution of the work.

d) Participation in seminars, workshops, and research group meetings, facilitating dissemination of the work and feedback from specialized researchers.

e) Development of international collaborations and establishment of the basis for future joint research projects.

Y para que conste a los efectos oportunos, se expide el presente certificado en Roma.

This certificate is issued in Rome for all appropriate purposes.

En Roma, a 21 de Abril de 2026
In Rome, on 21th April 2026

Fdo. / Signed: 

Prof. Giuseppe Attanasi
Sapienza Università di Roma

5. Participación en proyecto de investigación

Informe final de actividades

El alumno de doctorado Pablo Montero Lomas ha participado activamente y ha sido contratado de manera oficial como Técnico de apoyo a la investigación desde septiembre de 2021 hasta abril de 2023 en el proyecto "Estudio de Competencias y Habilidades sociales del alumnado de origen migrante en educación secundaria que informen sobre desigualdades y brecha educativa causadas por el Covid19", financiado por la Agencia Andaluza de Cooperación Internacional para el Desarrollo (AACID) [0I008/2020].

Los principales logros alcanzados por el alumno bajo lo planificado en el proyecto durante los meses de octubre de 2022 a abril de 2023 son:

Resultado 1: Encuentro de diferencias en integración social en los centros de secundaria entre migrantes y no migrantes.

- **R1.A1**. Planificación de las pruebas, cuestionarios y revisar el diseño de todas las tareas. Basado en los pilotos realizados anteriormente, se planificarán las pruebas adaptadas a los objetivos del presente proyecto, se ajustarán las tareas y se adaptarán para que todas/os las alumnos/as comprendan de manera adecuada las tareas a realizar.
- **R1. A2**. Contacto con colegios y propuesta de trabajo de campo. Se realizará el contacto con colegios y propuesta a participar: ofreciendo toda la información del estudio.
- **R1.A3**. Visitas a colegios y realización de pruebas.
- **R1. A5**. Análisis de datos. Tras la realización de pruebas en los colegios se realizará el análisis de los datos y se producirán resultados.

Resultado 2: Análisis de diferencias en habilidades (variadas) entre migrantes y no migrantes.

- **R2. A1**. Divulgación de resultados entre el sector educativo y las organizaciones andaluzas especializadas en el sector de la educación para el desarrollo y la ciudadanía global.
- **R2.A4**. Campaña de difusión de resultados y avances de resultados en las diferentes redes sociales. Realización de una campaña en redes sociales con mensajes que den difusión a los resultados del proyecto.

En Córdoba, a 18 de julio de 2023.

Los Investigadores Principales del Proyecto

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Dr. Lorenzo Estepa Mohedano

VAZQUEZ DE FRANCISCO MARIA JOSE - 30816709K
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Dra. María José Vázquez de Francisco

Tesis depositada en Universidad Loyola
Córdoba, 2026

Universidad
LOYOLA