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Preferences for Autonomous and Collective Risk-Taking in Adolescents and Young Adults

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ABSTRACT

This thesis investigates how collectives impact risk-taking differently in adolescents versus adults and how preferences for collective versus individual decision-making evolve throughout adolescence. Using a risk-taking task, participants made decisions either individually or within a group, presented with two options, one of which involved more risk. In one condition, participants were assigned to either autonomous or collective decision-making settings. While in the second condition, they voluntarily chose to join a collective or choose to decide autonomously. Results indicate voluntary collectives are more prone to risk-taking than individuals, with this effect being particularly amplified during mid to late adolescence. They also highlight that after experiencing the outcomes of autonomous decisions, the likelihood of voluntarily joining a collective decreases as adolescents get older.

Key Words: Collective Decision Making, Risk-Taking, Peer Influence

INTRODUCTION

Adolescence is a complex and multifaceted period marked by significant biological, psychological, and social transitions. While there is no stringent universal or unanimously agreed-upon definition, current literature does concur that adolescence generally covers the ages from 10 to 24, encompassing the years between childhood and adulthood (Pfeifer & Allen, 2021; Spear, 2009; Hawley, 2011). During this time, individuals experience a shift from family-centered to peer-oriented relationships, often accompanied by increased risk-taking behaviors (Reiter et al., 2021). This transition is often accompanied by increased risk-taking behaviors, particularly in social settings and under peer influence. According to the World Health Organization (2020), the leading cause of death in adolescents is unintentional injury (e.g. driving recklessly). Despite the prevalence and consequences of adolescent risk-taking, research has not fully explored the role of collective decision-making in this context. Specifically, there is a lack of understanding about how collective decision-making preferences develop as adolescents mature and how risk-taking differs in voluntary versus assigned group settings (El Zein et al., 2019; Khang et al., 2022). Given the heightened vulnerability of adolescents to risky behaviors and their associated consequences (Gluckman & Hanson, 2006; Steinberg, 2008), this thesis aims to examine the influence of collective decision-making on risk-taking in adolescents and young adults, addressing a critical gap in current research.

One essential social change in adolescents is the value they impose on their interpersonal relationships with peers and other adolescents, as well as the amount of time spent with them. This period of life is generally characterized by a significant shift of one's focus from that of familial connections to their cohorts (Tomova et al., 2021; Reiter et al., 2021). Adolescents

increasingly prioritize peer relationships, often at the expense of familial connections. This important shift from kinship to cohort is frequently accompanied by a notable rise in risk-taking behaviors (more than is measured by any other age group), which can be attributed to the complex exchange between peer influences and social media dynamics. (Chein et al., 2011; Sawyer et al., 2018).

Although, biologically these changes are observed as early as 9 years old, the mean age of onset for adolescent physical development begins around 11-12. Adolescent physical development is accompanied by one foundational change of striking importance: hormonal shifts, particularly measured via increased sex hormones like estrogen and testosterone (Pfeifer & Allen, 2021; Steinberg, 2008; Gunnar et al., 2009). These pivotal hormones dictate the onset of puberty and drive the development of secondary sexual characteristics, signaling reproductive maturity. Additionally, adolescents experience rapid physical growth, including a growth spurt, which leads to changes in body composition (Pfeifer & Allen, 2021; Spear, 2009; Gunnar et al., 2009; Hawley, 2019). Males typically experience increased muscle mass while females often exhibit alterations in fat distribution (Pfeifer & Allen, 2021; Spear, 2009; Hawley, 2011). Concurrent with these physical changes, the adolescent brain also undergoes substantial maturation-primarily in the prefrontal cortex. This region is responsible for higher-order executive functions like decision-making, impulse control, and emotional regulation (Pfeifer & Allen, 2021; Spear, 2009; Hawley, 2011). These biological and physical changes during this time frame lay the foundation for adult functioning and adaptation.

Simultaneously, adolescents undergo a profound transformation in their psychological landscape. One of the most striking alterations is an amplified stress response, where adolescents

display heightened reactivity to stressors, as evidenced by fluctuations in hormonal levels and autonomic nervous system activity (Pfeifer & Allen, 2021; Spear, 2009; Hawley, 2011). This heightened sensitivity to stress can intensify emotional reactivity, rendering adolescents more susceptible to intense emotions and mood swings. As previously discussed, the transition from childhood to adolescence commences an era of increased awareness regarding social dynamics, leading to more intricate peer relationships and a stronger emphasis on social acceptance and identity formation (Pfeifer & Allen, 2021; Spear, 2009). While adolescents navigate these changes, they characteristically encounter a mismatch between their biological maturation and psychosocial readiness (Gluckman & Hanson, 2006; Spear, 2009). Collectively, these psychological transformations during puberty influence behavior, emotional regulation, and social interactions.

During these transformations, adolescents commonly make decisions influenced by the prevailing opinions of their primary social circle, frequently deferring to a dominant voice within the group. (Khang et al., 2022). These types of decisions fall within the framework of collective decision-making, defined as the process by which members of a group collaboratively determine a consensus of action that affects all participants equally, without centralized leadership (Bose et al., 2017). One method of mentalization adolescents use to reach this consensus, in contrast with young adults, is referred to as a voting mechanism (Khang et al., 2022). The susceptibility of adolescents to peer influence is evident by the fluidity of their risk behaviors, as these can be significantly formed by the social context in which decisions are made. Research suggests that adolescents exhibit different risk profiles based on the context of their decisions; tending towards financial caution while demonstrating a marked increase in risk-seeking behavior concerning

life-related scenarios when in group settings (Pfeifer & Allen, 2021; Khang et al., 2022). These observations underline critical developmental distinctions between adolescents and adults, particularly regarding how social dynamics and the presence of influential peers shape decision-making processes.

While current research provides valuable insights into the influence of collective decision-making on risk-taking behavior during adolescence, notable gaps are demanding further investigation. Principally, the literature lacks a clear understanding of how preferences for collective risk-taking emerge as adolescents mature. It remains unclear how risk-taking behaviors differ between adolescents and adults when individuals are in collective settings compared to when they are making decisions independently. Secondly, there is a scarcity of comparative studies that analyze voluntary collective decision-making versus assigned collective decision-making between adolescents and adults. Analyzing the key differences and similarities in how these two age groups approach decision-making in group settings, concerning risk-taking behaviors, it is critical to clarify the unique characteristics of adolescent decision-making. Addressing these gaps in the literature will lead to a more comprehensive understanding of the developmental changes in collective decision-making preferences during adolescence and their implications for risk-taking behaviors.

Chapter 1: Adolescence: An Age of Opportunity and Vulnerability

Adolescents are not only influenced by their peers but also shape their environments as active change agents within their communities creating both opportunities and vulnerabilities. This prioritizes policies that promote engagement and collaboration with adolescents, extending

support into their third decade of life to help them acquire essential social, emotional, and economic assets (Pfeifer & Allen, 2021; Sawyer et al., 2018). However, the varying definitions of adolescence across cultures complicate the legal landscape. For instance, in one country where a 15-year-old may be deemed old enough to marry but in another, they are seen as too young to leave school (Sawyer et al., 2018).

The legal framework regarding adolescence often reflects a protective nature, with laws enacted as a safeguard for vulnerable youth while simultaneously empowering them. Recent reforms, such as New Zealand's recognition of the continuous needs of individuals up to 25 years old transitioning out of care, highlight the importance of adapting legal definitions to better support young people (Sawyer et al., 2018). Moreover, the rising educational demands of the modern economy require a reevaluation of the age at which adolescence is considered to end, as extended schooling necessitates prolonged dependence on family support. (Sawyer et al., 2018). Furthermore, adolescents have the obstacle of navigating the health care system as it has yet to fully recognize this period as critical for promoting healthy growth and development. The fragmentation of health services such as mental health and sexual health, as well as the dependence on parental consent often restrict adolescents' access to this necessary care (Sawyer, et al. 2018). Thus, emphasizing the necessity for more comprehensive health policies that address their unique and individual challenges.

Research indicates that while there are general patterns of structural and functional brain alterations during this time, such as changes in gray and white matter volumes, these alterations do not occur identically across all individuals (Gluckman, 2006). Factors such as genetics, environmental influences, and personal experiences contribute to variability in developmental

paths, leading to diverse outcomes and individual differences. Some adolescents may experience accelerated maturation in specific brain regions, instead, others may encounter delays, resulting in diverse emotional and cognitive responses (Foulkes & Blakemore, 2018).

In addition, individual differences in stress reactivity and emotional sensitivity during the time span of adolescence can significantly impact mental health outcomes. Adolescents who experience heightened sensitivity to stressors may become more vulnerable to developing psychological disorders, as their unique developmental trajectories interact with environmental pressures (Foulkes & Blakemore, 2018). In fact, more than half of all socioemotional mental health issues are first diagnosed during adolescents at around age 14, and two-thirds of lifetime cases by the age of 24 (Kessler et al., 2005). This nuanced perspective on adolescent development emphasizes the importance of considering both biological and environmental factors in addressing the mental health challenges faced by adolescents today (Gluckman, 2006; Foulkes & Blakemore, 2018).

Considering the biological change in which the brain undergoes extensive structural and functional alterations, particularly in regions associated with higher cognitive processes such as memory and emotional regulation; these changes could enhance developmental opportunities while simultaneously increasing the risk of mental health issues (Fuhrmann et al., 2015). A key factor that might be contributing to these vulnerabilities is the unique impact of sexual selection and sex differences; for example, externalizing disorders such as ADHD and conduct disorder are more prevalent in boys during childhood, while internalizing disorders like depression and anxiety become more common in girls during adolescence (Martel, 2013). This shift is mainly

attributed to hormonal fluctuations and social pressures that uniquely impact boys and girls, leading to varying expressions of psychopathology and possibly leading to more risky behaviors.

Furthermore, the appearance of many psychiatric disorders during adolescence can be connected to the maturation processes of the brain. Structural changes such as synaptic pruning and increased myelination are crucial for developing cognitive control and decision-making abilities, however, the lack of maturity in these systems can result in risk-taking behaviors and emotional instability, heightening the chance of mood disorders and substance abuse (Paus, 2008). The interaction between these neurobiological developments and external stressors—such as social pressures, academic demands, and identity formation—creates a complex landscape of vulnerability. Adolescents are particularly sensitive to stress due to the fact that their stress-response systems are still maturing, and prolonged exposure to stress may lead to dysregulation of the hypothalamic-pituitary-adrenal (HPA) axis, further increasing the risk for anxiety disorders and depression (Fuhrmann et al., 2015).

Along with these obstacles, is an increase in neuroplasticity which enhances their learning capabilities, including improved recall of autobiographical memories and more effective learning in abstract reasoning (Towner, Chierchia, & Blakemore, 2023). Adolescents also show a greater inclination for second language acquisition, development in musical taste, and sociocultural learning (Towner, Chierchia, & Blakemore, 2023). However, this deepened learning ability is accompanied by vulnerabilities. The peak age for the onset of various mental health conditions occurs around 14.5 years, and adolescents are particularly reactive to both positive and negative emotions (Towner, Chierchia, & Blakemore, 2023). Social contexts tend to amplify their emotional experiences. Neurodevelopmental changes in reward-related circuitry

and the ongoing maturation of the prefrontal cortex contribute to this heightened vulnerability. (Towner, Chierchia, & Blakemore, 2023).

The article by Fuhrmann, Knoll, and Blakemore (2015) also explores the concept of the "reminiscence bump," a phenomenon where individuals around the age of 35 exhibit a stronger ability to recall autobiographical memories from their adolescence and early adulthood, specifically between the ages of 10 and 30. This effect is consistently observed across various mnemonic tests and cultural backgrounds, indicating a robust pattern in memory recall. In addition to significant life events, individuals demonstrate heightened recall of cultural artifacts such as music, films, and public events from this developmental stage, suggesting an elevated mnemonic capacity during adolescence. Research indicates that even ordinary experiences from this period are disproportionately represented in memory, with peaks in both verbal and visuospatial memory capabilities noted between the ages of 14 and 26. These findings imply the existence of sensitive periods for memory development during adolescence, highlighting the need for further experimental studies to investigate these sensitive periods and their implications for cognitive functioning throughout life.

Likewise, due to the heightened neuroplasticity and significant developmental changes occurring in the brain during adolescence, there is another critical period for cognitive training. The study by Knoll and colleagues (2016) highlights the potential for targeted cognitive training interventions to enhance specific mental abilities such as numerosity discrimination and relational reasoning. Their results show that while discrimination training benefits older adolescents and adults, relational reasoning training is effective across all age groups, with the most robust improvements seen in late adolescence and adulthood. Interestingly, face perception

training did not yield significant performance enhancements in any age group. These insights underline the importance of late adolescence as an optimal time for cognitive training.

All these changes in adolescence align with another concept of adolescence called social reorientation. The idea of social reorientation in adolescence refers to the developmental shift where individuals begin with a dependency on adults, such as their parents, and then gradually turn towards their peers for social support, guidance, and influence (Choudhury, 2009). This process is in junction with the increasing autonomy that adolescents experience as they move away from the adult figures in their lives (Choudhury, 2009). As noted before cultural factors significantly influence adolescents, especially how autonomy is expressed and valued. In collectivist societies, autonomy might not be equal to independence from parents but instead could involve taking on more familial responsibilities; on the contrary in individualistic cultures, autonomy is usually linked with personal independence and separation from parental guidance (Choudhury, 2009). This social reorientation is crucial as it highlights the development of personal identities and prepares adolescents for adult roles. Nevertheless, the intensity and nature of this reorientation varies across cultures, influenced by cultural norms concerning adolescent independence, family structures, as well as expectations of adolescent behavior (Choudhury, 2009).

Thus, the social reorientation of adolescents is a multifaceted process that encompasses diverse and significant changes, underlining the necessity of recognizing adolescents as active participants within their communities. This transformative period is distinguished by substantial brain development, including synaptic pruning and increased myelination, which enhance cognitive control and decision-making abilities (Paus, 2008). However, these

neurodevelopmental changes also render adolescents more vulnerable to risk-taking behaviors and emotional instability, which can lead to mental health challenges (Fuhrmann et al., 2015). The biological, environmental, and social changes, along with the vulnerabilities characteristic of adolescence, significantly could influence how adolescents approach risk-taking decisions both collectively and individually.

Chapter 2: Risk-Taking During Adolescence

Risk-taking is classified as engaging behaviors that have uncertain outcomes, whether those outcomes are health-related, social, or even legal (Tomova et al., 2021). Research investigating age differences in risk-taking behavior among adolescents and young adults has produced mixed results, indicating a need for further exploration of this phenomenon. A robust study involving 5,404 participants aged 10 to 30 from eleven countries found that risky behaviors tend to increase during adolescence, peaking in late adolescence and subsequently declining in young adults as they mature into their early twenties (Steinberg et al., 2017).

However, risk-taking behavior varies significantly across cultures, formed by cultural norms, social values, and individual attitudes regarding risk. In more individualistic societies, like the United States and Australia, people usually partake in independent risk-taking activities, whereas in collectivist cultures such as South Korea and China, risk-taking is more commonly aligned with the interests of their perspective group (Duell et al., 2023). Additionally, the amount of uncertainty avoidance within a culture also could impact risk behavior. For example, in cultures with low uncertainty avoidance, such as the United States, there is a higher allowance for ambiguity and a greater inclination for risk-taking. On the contrary, cultures with high

uncertainty avoidance, like Japan, hold a preference for more structured environments and are in general more adverse to risk (Duell et al., 2023). The presence of economic stability and strong social safety nets may be critical factors that encourage risk-taking behaviors, as individuals in countries with effective support systems typically feel more secure (Duell et al., 2023).

There are two categories of risk-taking behaviors referred to in the literature as "hot" and "cold", each reflecting different types of decision-making processes. "Hot" risk-taking occurs when situations are emotionally charged when decisions are made quickly, impulsively, and often driven by increased sensation-seeking and immature self-regulation (Figner et al., 2009; Steinberg et al., 2017). This type of risk-taking is most commonly witnessed in behaviors like reckless driving, substance use, and unprotected sex, typically happening in the presence of peers, when emotional arousal is heightened and the desire for instant gratification often outweighs potential long-term consequences. Within the developing brain, the prefrontal cortex plays an essential role in this type of decision-making, as it is not completely matured, leading to a greater inclination for impulsive actions. In contrast, "cold" risk-taking is more deliberate, with more calculated decisions made in calm, non-emotional situations; for example, engaging in challenging academic projects or extracurricular activities (Figner et al., 2009; Pfeifer et al., 2021). These types of decisions tend to be influenced by logical reasoning and planning, characterized by the adolescent's developing cognition as well as the desire to explore new opportunities. Cold risk-taking doesn't have the interference of emotional arousal, allowing for more careful consideration of potential risks and benefits (Figner et al., 2009).

To summarize, risk-taking can have cultural factors shape the approaches made by adolescents. In societies that value individualism, risk-taking is connected to personal

independence and exploration, while in collectivist cultures, risk-taking corresponds with group interests and social dynamics (Duell et al., 2023). Cultures with low uncertainty avoidance typically demonstrate higher rates of risk-taking (Duell et al., 2023). Risk-taking behaviors among adolescents are influentially formed by neurodevelopmental changes, social dynamics, and cultural contexts. Adolescence is marked by significant brain development in regions associated with reward processing and impulse control, which contributes to an increase in risk-taking behaviors (Steinberg et al., 2017). As previously noted, these behaviors can be labeled as "hot" (impulsive decisions in emotionally charged situations) or "cold" (calculated and computed decisions in calmer environments) (Pfeifer et al., 2021). Despite the existing literature on risk-taking behaviors, further exploration is still needed in understanding how these behaviors manifest differently across age groups, especially concerning the heightened risk-taking during adolescence in social context.

Chapter 2.1 Neurobiology of Risk-Taking

Another reason adolescence is regarded as a critical developmental phase is the abundance of significant neurobiological changes that occur. For example, the continuation of white matter development, and heightened ventral striatum activation influencing reward sensitivity and cognitive processes essential for understanding decision-making and risk-taking behaviors (Steinberg et al., 2017). The Lifespan Wisdom Model (LWM) provides a detailed framework for distinguishing between adaptive and maladaptive forms of risk-taking during this period. According to Khurana et al. (2018), amplified sensation-seeking during adolescence is considered normative, and adaptive, and is motivated by the need to explore and learn from one's

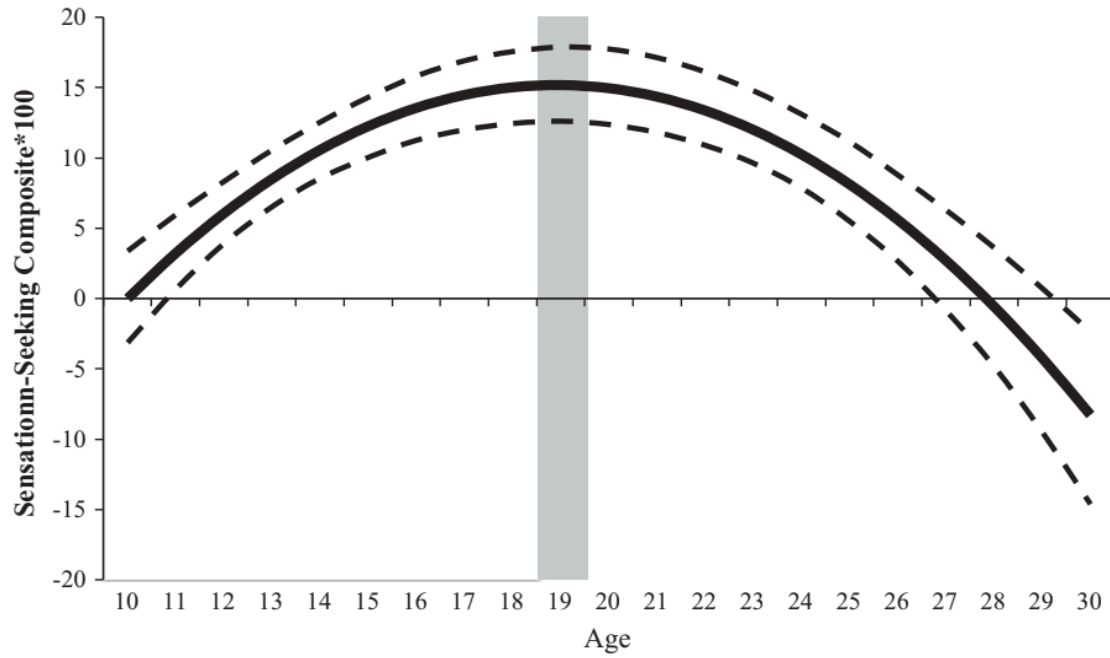
environment. This type of adaptive risk-taking does not automatically correspond with negative outcomes, such as substance use disorders. In contrast, maladaptive risk-taking behaviors, are characterized by high impulsivity and weak cognitive control, and result more frequently in adverse outcomes such as unplanned pregnancy or addiction (Khurana et al., 2018).

To exemplify the relationship between age and risk-taking behavior, one can examine the inverse U-curve shown in Fig. 1. Research suggests that adolescents demonstrate a heightened sensitivity to rewards, mainly as a result of continuous neurodevelopmental alterations in the brain's reward system, particularly the maturation of the prefrontal cortex (Steinberg et al., 2017). In laboratory settings, adolescents often partake in more risk-taking, possibly as a result of heightened intense motivation for immediate gratification. Research indicates that adolescents are more influenced by social rewards, such as peer approval, compared to adults, which can result in impulsive decision-making during emotionally charged situations (Duell et al., 2017).

At the same time, the inverse U-shaped relationship becomes more complex when applied to real-life situations. While adolescents usually participate in risk-taking behaviors more frequently than adults, the context of these decisions greatly influences the outcomes. The presence of peers amplifies risk-taking tendencies in real-life scenarios, as adolescents typically value social acceptance over potential long-term consequences (Steinberg et al., 2017). This kind of social pressure may potentially lead to maladaptive behaviors, like reckless driving or substance use. These maladaptive behaviors are less prevalent in adults as they tend to evaluate risks more carefully due to more experience, wisdom, and advanced cognitive control mechanisms.

The LWM emphasizes how cognitive control plays a critical role in moderating risk-taking behaviors. When adolescents possess better cognitive control skills, they are more equipped to handle their impulsive urges and are less prone to engage in maladaptive risk-taking. In contrast, those with weaker cognitive control are more likely to engage in impulsive behaviors, which can lead to adverse outcomes (Khurana et al., 2018). Studies supporting the LWM have discovered distinct developmental trajectories for different types of risk-taking behaviors. Sensation-seeking follows a somewhat universal trajectory, reaching its peak during adolescence and declining into adulthood as seen in Figure 1 (Steinberg et al., 2017). However, impulsive behaviors, such as acting without thinking and delay discounting, display more varied patterns, with only a portion of adolescents exhibiting high levels of these behaviors (Khurana et al., 2018).

To summarize, the interaction between neurobiology, reward sensitivity, and cognitive control during adolescence illuminates the unique characteristics found in this developmental stage. The inverse U-shaped relationship between age and risk-taking behavior underlines the significance of understanding these dynamics in order to promote healthy decision-making and resilience among adolescents.



(Fig. 1 The association between age and sensation-seeking is characterized by an inverse-U shape, peaking around age 19 as indicated by the shaded area, and declining for both younger and older age groups. By Steinberg et al., 2017).

Chapter 3: Social Determinants of Risk-Taking During Adolescence

Peer influence is a significant social determinant that shapes behaviors and attitudes during adolescence, particularly during the process of social reorientation. Research indicates that the mere presence of peers can dramatically alter an individual's behavior, with adolescents engaging in riskier activities compared to adults when peers are present (Chein et al., 2011). This heightened susceptibility to peer influence is especially notable in relation to self-injurious behavior and psychopathology. While peer pressure is often framed negatively, it can also serve as an adaptive component essential for healthy development (Reiter et al., 2021).

Research by Knoll et al. (2016) highlights how adolescents are particularly susceptible to peer influence, which can lead to increased risk-taking and negative outcomes, such as substance abuse and delinquency. This susceptibility is attributed to ongoing brain development, particularly in the prefrontal cortex, which is crucial for decision-making and impulse control, while the limbic system, responsible for emotional responses and reward-seeking, is more developed. As a result, adolescents often prioritize social acceptance over potential negative consequences, leading to riskier choices in peer contexts (Knoll et al., 2016).

Conversely, recent studies, such as those by Chierchia et al. (2020) and Molleman et al. (2022), suggest that peers can also exert positive influences, promoting prosocial behavior and rule compliance. Chierchia et al. (2020) found that observing compliant peers could enhance rule-following and reduce selfish behavior among adolescents. Molleman et al. (2022) further explored this duality, showing that while exposure to disobedient or selfish peers could provoke rule violations and reduce prosociality, compliant peers could significantly encourage adherence to social norms and altruistic behavior. Their findings indicate that early adolescents are

particularly influenced by peer behavior, as they often lack a clear understanding of their values, making them more susceptible to social information (Molleman et al., 2022).

Another mechanism that may relate to adolescent susceptibility to peer influence could be increased uncertainty regarding their own preferences, although this eventually decreases as they gain more assurance in themselves (Reiter et al., 2021). This preference is mainly attributed to developmental changes in the medial prefrontal cortex, a part of the brain that plays a key role in decision-making and social cognition (Reiter et al., 2021).

As individuals transition from adolescence to adulthood, their relationship with peer influence undergoes significant changes. Adults typically exhibit a more secure sense of self and are less swayed by the opinions of their peers. This shift is largely attributed to neurobiological changes that occur during adolescence, which diminish sensitivity to peer influence as individuals mature (Knoll et al., 2016). Another example of this change is that the majority of crimes committed by adolescents occur in the presence of peers, whereas adults tend to commit these offenses alone (Gardner & Steinberg, 2005). This raises important questions about whether this pattern is a result of adults spending less time with peers or their reduced susceptibility to peer influence.

Adolescents' increased sensitivity to potential rewards and decreased impulse regulation, along with the interaction between peer influence, reward-seeking, and risk-taking, may explain their tendency to engage in more risk-taking behavior with peers than when alone, particularly in contrast to adults (Chein et al., 2011; Hare et al., 2009). This heightened sensitivity to peer opinions underscores the complexity of social determinants in risk-taking behavior especially in collective settings.

Collective decision-making is prevalent in various important and everyday contexts, influencing risk-taking behaviors in both adolescents and adults. For instance, adults may experience peer influence in settings such as jurors voting on a verdict or parliamentary members deciding on a policy, while adolescents may face similar pressures when a group of peers decides whether to experiment with a new drug. These collectives can emerge circumstantially or be voluntarily joined or abandoned, yet both phenomena have received limited attention in the experimental literature.

Chapter 4: Collective Risk-Taking

In collective decision-making contexts, various psychological processes significantly influence how individuals approach risk-taking behaviors compared to autonomous decision-making. One key process is the diffusion of responsibility, where responsibility for outcomes is shared among group members, leading individuals to feel less personally accountable for their choices (El Zein et al., 2019). This diffusion can diminish personal accountability, potentially resulting in increased risk-taking behavior in group settings. Additionally, decreased sensitivity to anticipated outcomes—whether gains or losses—occurs in collective decisions, as individuals may experience outcomes with less intensity than when making decisions alone (El Zein et al., 2019). This reduced sensitivity can further encourage risk-taking in groups.

Another important factor is mutual reliance, particularly in situations of preference uncertainty. Individuals may defer to collective decision-making processes, such as voting, rather than trusting their own judgment (Lloyd & Döring, 2019). This tendency to rely on group

consensus can amplify risk-taking behaviors, especially if the group's decision leans towards riskier choices. The interaction of these psychological processes can reinforce each other, leading individuals to take greater risks in collective settings compared to when they decide independently.

Evidence suggests that both adolescents and adults exhibit a tendency to engage in riskier behaviors in collective decision-making scenarios. For instance, Sutter (2007) found that teams often invest higher amounts in risky assets compared to individuals, indicating that social dynamics in group decision-making can alleviate loss aversion and promote a greater tolerance for risk. However, adolescents, navigating the complexities of social interactions, may show an even higher acceptance of risky decisions among peers than adults.

Previous findings in adults and adolescents suggest that collectives might increase risk taking relative to making the same decisions alone. However, it remains unclear if this effect varies with age. More knowledge of the various social dynamics and environmental factors that influence collective risk-taking behaviors across different age groups is required. As individuals navigate this critical developmental period, the exchange between their reduced sensitivity to losses and increased reward-seeking tendencies in group contexts presents unique challenges that must be addressed to prevent adverse outcomes (Glatzle-Rützler et al., 2015; Sutter, 2007).

Chapter 4.1: Assigned vs. Voluntary Collectives

It is important to note the distinctions between assigned collectives and voluntary collectives. Assigned collectives, primarily organized within institutional settings such as workplaces or schools, are different from voluntary collectives because the “membership” of the

group is determined by external circumstances rather than personal preference (El Zein et al., 2019). In assigned collectives, members are expected to participate according to the roles that are pre-determined by the institution, which are governed by established rules or norms. Conversely, voluntary collectives are created when individuals make their own choice to join, typically based on shared interests, values, or objectives, which are driven by intrinsic mechanisms such as social belonging or the pursuit of common goals (El Zein et al., 2019).

Individuals often gain "membership" in assigned collectives due to external obligations or the desire to obtain benefits such as social status or job security (El Zein et al., 2019). In these groups, participation is typically governed by compliance with organizational rules, which can lead to a sense of diminished personal accountability. In contrast, individuals join voluntary collectives driven by personal interests or a need for mutual support, which fosters a more democratic governance structure that encourages all members to participate in decision-making processes (El Zein et al., 2019).

Preferences for joining assigned or voluntary collectives could differ significantly with age. For instance, younger individuals may be more inclined toward voluntary collectives as they are eager to establish their identities and social networks outside formal institutions, adolescents also could appreciate the flexibility and autonomy voluntary groups offer. However, to date, only one study has investigated preferences for collective decision-making among adults. research conducted by El Zein et al. (2019) found that adults often prefer to make decisions collaboratively rather than individually. Therefore, there is currently no understanding of how this preference may vary across different age groups.

There is a critical distinction between assigned collectives and voluntary collectives, which may significantly impact risk-taking behavior. While existing research has examined these two types of collectives separately, a direct comparison of their effects on risk-taking is lacking. For example, studies by Lloyd and Döring (2019) and Sutter (2007) have focused on assigned collectives, revealing that individuals often defer to group consensus and invest in riskier assets. Conversely, El Zein et al. (2019) explored voluntary collectives, finding that young adults prefer collaborative decision-making. However, it remains unclear how these preferences vary with age.

To fully understand the influence of collective decision-making on risk-taking, it is essential to compare assigned and voluntary collectives directly. Investigating psychological processes such as diffusion of responsibility, decreased sensitivity to outcomes, and mutual reliance can provide insights into their differential effects on risk-taking behavior. Additionally, examining how these processes interact with age-related factors, particularly the developmental imbalance between affective and deliberative systems during adolescence, may illuminate the unique challenges individuals face in collective decision-making scenarios.

In conclusion, the difference between assigned and voluntary collectives is based on the nature of membership and the mechanisms driving this participation. While assigned collectives are motivated by external obligations and more structured roles, voluntary collectives are driven by shared interests/goals and personal choices. The mechanisms that support participation in these distinct groups vary accordingly, as preferences for these two types of collectives can differ significantly with age, reflecting the ever-changing needs and values of individuals as they progress through different life stages (El Zein et al., 2019). Additionally, understanding the interplay between peer influence and myopic loss aversion in collective decision-making

provides valuable insights into the risk-taking behaviors of adolescents and the factors that shape their choices.

Chapter 5: Current Study

As outlined in an earlier section of this thesis, while current research provides valuable insights into the influence of collective decision-making on risk-taking behavior during adolescence, notable gaps demand further investigation. Primarily, the literature lacks a clear understanding of how preferences for collective risk-taking emerge as adolescents mature. It remains unclear how risk-taking behaviors differ between adolescents and adults when individuals are in collective settings compared to when they are making decisions independently.

Secondly, there is a scarcity of comparative studies that analyze voluntary collective decision-making versus assigned collective decision-making between adolescents and adults. Analyzing the key differences and similarities in how these two age groups approach decision-making in group settings, concerning risk-taking behaviors, is critical to clarify the unique characteristics of adolescent decision-making.

Therefore the current study aims to address two key questions:

- 1) Do collectives differently impact risk-taking behavior in adolescents compared to adults?
 - 1.1) Does this depend on whether collectives are assigned or voluntary?
- 2) How do preferences for collective versus individual decision-making change with age during adolescence?

While examining these questions, the current study will provide insights into the developmental trajectories of risk-taking and decision-making preferences throughout the transition from adolescence into adulthood. These insights could enhance our comprehension of the social and cognitive influences that shape decision-making under uncertainty across this important developmental stage. It is also important to address these gaps in order to develop interventions that empower adolescents to make informed decisions and promote their well-being during this transition into adulthood.

METHODS

Participants

The study consisted of a total of 290 participants which were categorized into four age groups: young adolescents, mid-adolescents, young adults, and adults. However, participants that discontinued the task before initiating phase two (n=15) or stopped before completion (n=14) were not included, therefore the final sample was 261 participants. The young adolescent group included 35 females and 26 males ages 11 to 14. The mid adolescents group had 37 females, 35 males, and one who identified as other, ages 15 to 18. The young adults group included 39 females and 27 males ages 19 to 24. The adult group consisted of 28 females, 29 males, and three who identified as other, ages 25 to 39. All participant demographics can be found in Table 1 below.

	Young Adolescents	Mid Adolescents	Young Adults	Adults
Age Range	11-14	15-18	19-24	25-39
M (SD)	13.06 (0.99)	16.93 (0.96)	20.39 (1.56)	29.38 (3.47)
Female	35	37	39	28
Male	26	35	27	29
Other	1	1	0	3
Total	62	73	66	60

Table 1 Participants Demographics

Recruitment and Procedure

The COVID-19 pandemic presented numerous obstacles worldwide, including intermittent lockdowns which led to most research studies between 2019 and 2022 to move to online data collection methods. This study's transition to online data collection methods during that time was paramount in ensuring completion and minimizing disruptions. Therefore, it is necessary to mention that most of the data was gathered in an online environment rather than in a controlled laboratory setting. In order to address any potential confounds associated with online experiments, (e.g. increased inattention compared to in-person studies), the recruitment target was increased to more than double the standard sample sizes typically recommended in comparable lab-based investigations of social decision-making across adolescence and adulthood. Additionally, participants were asked to complete attention check questions (ACQs) to account for the inattention prevalent in modern online surveys. These questions also served as a screening procedure, and were used to exclude participants who consistently selected the same response for each question.

Data collection methods varied depending on participant age group. Participants under the age of 18 were recruited through popular social media platforms, via posts on Twitter and Facebook, as well as in-person communications in the form of school-wide announcements at participating universities. A total of 10 schools located within the United Kingdom participated in the study. Of the 10 schools, 3 were co-ed state-maintained schools, 5 were co-ed independent schools, and 2 were single-gender independent schools. Participants over the age of 18 were also recruited via social media (e.g., Twitter and Facebook), in addition to the participant databases at the University of Cambridge and University College London. All participants were instructed to

complete the experiment independently using any available electronic device. All participants provided informed consent and the study protocol was approved by the university's ethics review board. After providing electronic informed consent, and parental informed consent for participants under 18 years, participants were sent a link to the online task via email.

Collective Risk-Taking Task

To examine decision-making under risk, participants were allocated 50 tokens per trial and instructed to select between a “small” coin flip and a “large” coin flip by clicking on the corresponding image (Fig. 2) (De Martino et al., 2010). The “small” coin flip option offered a potential gain or loss of 5 tokens, depending on the result of the coin flip. Although this choice entailed some degree of risk, it consistently presented a lower risk compared to the alternative and was therefore labeled as the “safe” option.

Conversely, the “large” coin flip provided participants with the opportunity to gain or lose more than 5 tokens. Specifically, selecting this riskier option could result in winning 85 tokens or losing 20 tokens. Alternatively, if participants opted for the safe choice, they would either conclude the trial with 55 or 45 tokens. This option was labeled as the “risky” choice.

Participants received compensation for their participation and were informed that tokens held additional value as they were equivalent to lottery tickets for a £20 Amazon voucher, which would be awarded at the end of the experiment. Furthermore, participants were informed that this bonus payment would depend entirely on the tokens earned during a randomly selected trial at the conclusion of the experiment. This single-trial incentivization, a standard practice in behavioral economics experiments, was employed to prevent participants from employing

sequence-related strategies, such as taking risks on a specific trial due to perceived accumulated gains from earlier trials.

In this study, each trial presented participants with a two-outcome risky gamble that offered a 50% chance of either gaining or losing the displayed amounts. Participants indicated their willingness to accept the gamble by pressing a key. The expected value (EV) of each risky gamble was calculated as $0.5 * \text{Gain magnitude} + 0.5 * \text{Loss magnitude}$. Since the safe option always had an EV of 0, risk-neutral participants were expected to choose the risky option whenever its EV was greater than 0 (Fig. 4).

To further analyze the data, each combination of gain and loss values was represented on a 5x5 matrix, with red indicating a high probability of gamble acceptance and yellow indicating a low probability (Fig. 3). This streamlined visualization facilitated a clear comparison of risk preferences between individuals and collectives. During the experiment, the outcomes of the risky gambles were pseudo-randomly selected without replacement from this matrix.

This task was adapted from De Martino et al. (2010), where one option was risky and the other was entirely safe. However, in the present study, both options involved varying levels of risk, with one option being consistently riskier. This modification was implemented to facilitate a subsequent investigation into how participants responded to the outcomes of their decisions. In scenarios where one option is safe, the outcome is certain, thus providing no new information regarding the decision-making process.

In order, to account for the different types of collectives, this experiment had 3 different phases (Fig. 5):

Phase 1: Main Dependent Variable is Choice (Risk vs. Safe)

In the initial phase of the experiment, participants were instructed to make decisions in an environment without any feedback, specifically designed to diminish potential outcome effects, such as learning from prior choices or results. This methodology ensured that participants' decisions were unaffected by knowledge of their own or others' outcomes. Consequently, participants were not informed about the decisions made by their peers. They also did not receive any information regarding the outcomes of the subsequent coin flips that followed their choices.

To mitigate order effects, the sequence of the two decision-making conditions—collective and individual—was pseudorandomized and counterbalanced among participants. This method guaranteed that the order in which participants experienced the collective and individual conditions was varied systematically, evenly distribute any potential biases arising from the order of presentation among the participants. Each participant engaged in both conditions, enabling within-subject comparisons of decision-making behavior across different contexts.

Phase 2.1: Main Dependent Variable is Group Preference (Individual vs. Group)

In phase 2.1 of the experiment, participants received feedback regarding the outcomes of their decisions made during phase 1. While the outcomes were presented as random, the gains and losses were systematically counterbalanced across different conditions to maintain the integrity of the experimental design and alleviate potential biases. When disclosing the outcomes of group decisions, results were categorized into two distinct scenarios: one in which the participant's choice aligned with the majority of the group and another in which it was in the minority. This categorization was also counterbalanced to ensure that participants experienced a

balanced representation of both majority and minority conditions, thereby helping to avoid distorted perceptions of group influence.

Following the feedback, participants were required to make decisions again. In contrast to Phase 1, participants were initially asked to indicate their preference for making decisions either independently or in a collective context. To prevent the formation of preferences based on specific dynamics of any prior group, participants were informed that they would not be assigned to the same collective as before. This measure ensured that participants could not infer or anticipate the risk preferences of any specific group, thereby maintaining the focus on the decision-making process rather than on the individual members of the group.

Phase 2.1 introduced a new dependent variable of interest: participants' preferences for collective versus autonomous risk-taking. The phase comprised a total of 48 trials, evenly divided among three conditions: 16 trials in the alone condition, 16 in the majority condition, and 16 in the minority condition. This design allowed participants to indicate their preferences for various decision-making contexts, providing insights into how their experiences of being in the majority or minority during group decisions affected their subsequent choices in Phase 2.1.

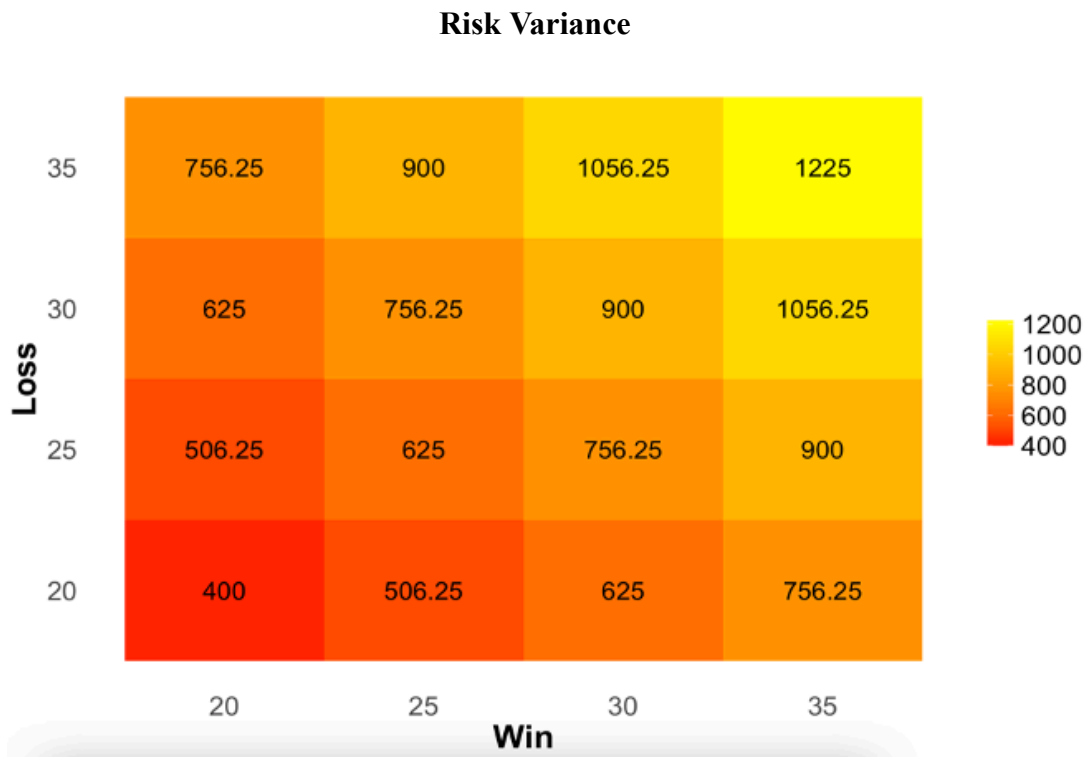
Phase 2.2: Main Dependent Variable is Choice (Risk vs. Safe)

In Phase 2.2 of the experiment, participants had previously experienced the outcomes of their decisions. They indicated their preferences for making subsequent choices either independently or within a collective context. Following this, they proceeded to make decisions in a manner similar to that of Phase 1. The key distinction in this phase was that participants voluntarily selected whether to engage in collective decision-making or to act independently.

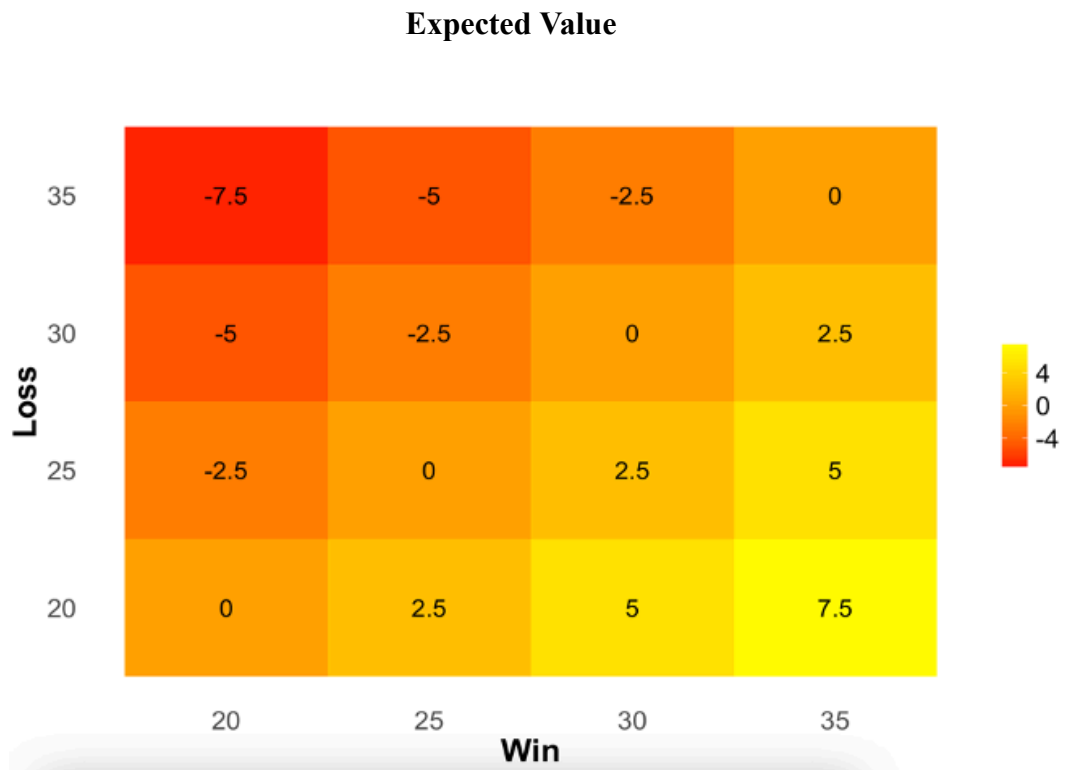
Similar to Phase 2.1, this phase consisted of a total of 48 trials, with 16 trials dedicated to each of the three conditions: alone, majority, and minority.

Each trial followed a structured sequence. Participants began by recalling their previous choice, then observed the decision made by the majority, which was simulated through a coin flip. After this, they viewed the outcome of that decision. Finally, participants were required to make a final decision, which served as the primary dependent variable, categorizing their choice as either risky or safe. When combined with the 32 decisions made in Phase 1, each participant completed a total of 80 decision trials throughout the experiment.

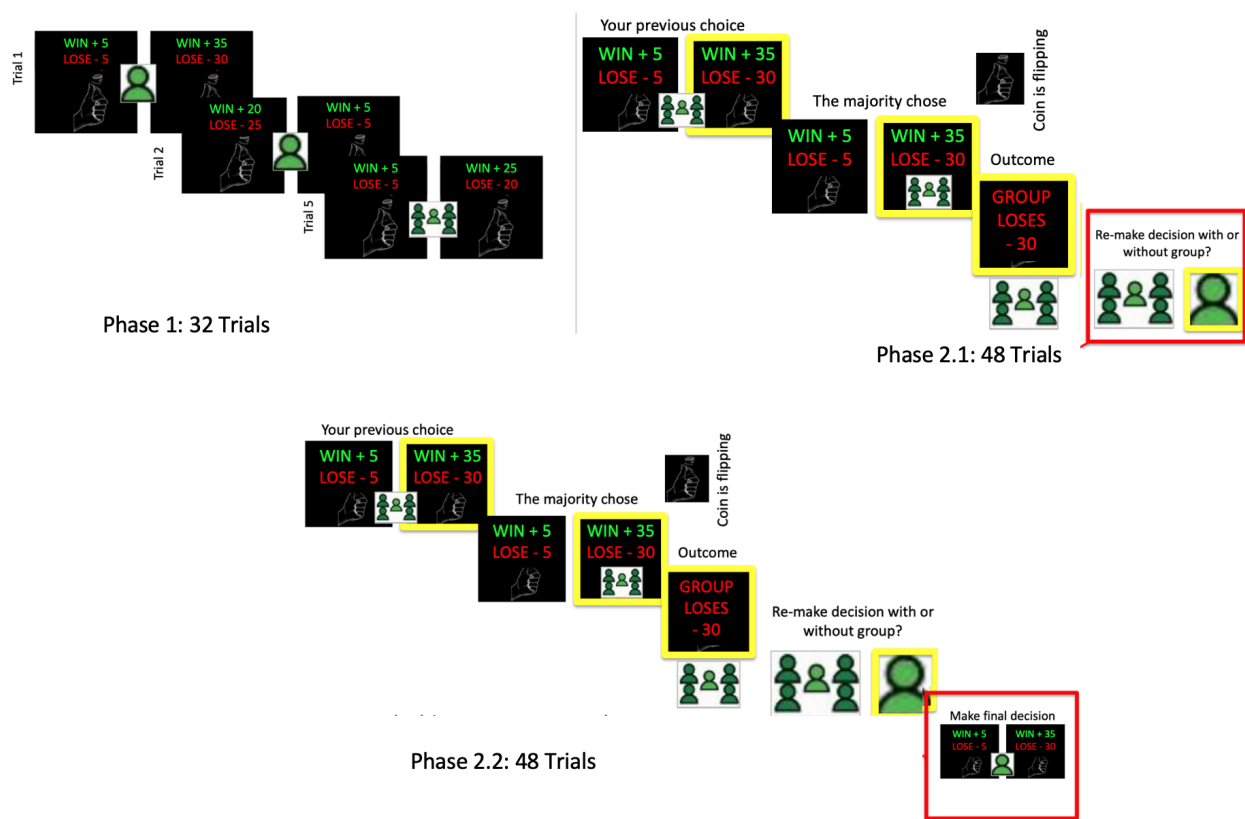
This design enabled a comprehensive analysis of risk preferences in the context of voluntary collectives compared to individual decision-making, providing valuable insights into how the dynamics of group participation influence subsequent choices. By allowing participants to make decisions in a context where they could choose their preferred decision-making approach, the experiment sought to clarify how collective and individual risk-taking affects overall decision outcomes.



(Fig 3. Illustrates risk variance across different win-loss scenarios, with 'Win' values on the horizontal axis and 'Loss' values on the vertical axis, both ranging from 20 to 35. Each grid cell represents a specific win-loss combination, with numerical values indicating the outcome. The color gradient, from yellow to red, visualizes variance: lighter yellow indicates lower variance, while darker red signifies higher variance. For instance, dark red represents high variance (e.g., 400), and light yellow indicates low variance (e.g., 1225), effectively highlighting varying risk levels.)



(Fig. 4 Visualizes expected values across win-loss scenarios, with 'Win' values on the horizontal axis and 'Loss' values on the vertical axis, both ranging from 20 to 35. Each cell represents a specific win-loss combination, with the numerical value indicating the expected value. The color gradient from red to yellow reflects the expected values: red denotes negative values (higher losses), orange indicates neutral values, and yellow signifies positive values (higher wins). This color-coding aids in evaluating potential outcomes and decision-making strategies.)



(Fig. 5 This figure illustrates the experimental design used to study decision-making behavior under different conditions. In Phase 1, participants made individual decisions between risk and safe options without feedback, ensuring choices were unaffected by prior outcomes. The sequence of decision-making conditions was pseudorandomized and counterbalanced to mitigate order effects. Phase 2.1 introduced feedback on outcomes, with results categorized based on alignment with group majority or minority preferences. Phase 2.2 involved collective decision-making with group discussions influencing choices. This design allowed for within-subject comparisons across individual and collective contexts, maintaining experimental integrity through systematic counterbalancing of outcomes.)

Statistical Analysis

To analyze the complex relationships between age, decision-making context, and risk-taking behavior, we employed two generalized linear mixed models (GLMMs): the Risk Model and the Autonomous vs. Collective Preference Model. These models were chosen to account for the binary nature of our main outcome variables (risk: safe vs. risky; preference: autonomous vs. collective) and the repeated measures design of our study.

Both models were implemented using the `glmmTMB` function from the `glmmTMB` package in R. To account for the binary nature of our outcome variables, the models were generalized to the binomial family and used a logit link function to move between probabilities and log-odds. This approach allowed us to appropriately model the non-linear relationships in our data while accounting for the nested structure of repeated observations within participants.

The Risk Model examined how age, collective condition, and condition type influenced participants' choices between safe and risky options. The model included the following components:

Fixed effects:

Age: Modeled as an orthogonalized cubic polynomial

Collective Condition: Alone vs. Collective

Condition Type: Voluntary vs. Assigned

Expected Value and Variance (covariates)

Random effects:

Random intercepts for participants

Random slopes for collective condition and condition type

The Autonomous vs. Collective Preference Model investigated factors influencing participants' preference for autonomous vs. collective decision-making. It included similar components to the Risk Model:

Fixed effects:

Age: Modeled as an orthogonalized cubic polynomial

Condition Type: Voluntary vs. Assigned

Random effects:

Random intercepts for participants

Random slopes for condition type

A key focus of our analysis was on the interactions between our main variables of interest. Both models included all possible two-way interactions, as well as a three-way interaction between age, collective condition (for the Risk Model), and condition type. These interactions were crucial for understanding how the effects of one predictor might vary depending on the levels of other predictors.

The three-way interaction in the Risk Model allowed us to examine whether the relationship between age and risk-taking differed not only between individual and collective contexts but also between voluntary and assigned group conditions. This complex interaction provided insights into how social context and the nature of group formation jointly moderated age-related patterns in risk-taking behavior.

To evaluate the significance of fixed effects and interactions, we conducted Type III ANOVAs using the car package in R. Significant omnibus tests were further examined using Tukey-corrected planned contrasts and trend analyses, implemented with the emmeans package.

These post-hoc analyses allowed us to decompose significant interactions and assess specific hypotheses about age-related trends in risk-taking and group preference across different conditions.

By employing this comprehensive statistical approach, we were able to rigorously examine the complex interplay between age, social context, and decision-making processes, while accounting for the nested structure of our data and the binary nature of our outcome variables.

RESULTS

Our analysis of risk-taking behaviors revealed a general trend of decreasing risk-taking as individuals age. The overall age trend yielded a negative estimate of -0.0349 with a standard error of 0.0188, suggesting a slight reduction in the propensity for risk-taking as age increases. The z-ratio of -1.858 approaches statistical significance, with a p-value of 0.0632. Although this does not meet the conventional significance threshold ($p < 0.05$), it is close enough to warrant attention. This implies that younger individuals may be more inclined to take risks compared to older individuals. The asymptotic confidence intervals for this trend ranged from -0.0718 to 0.00193, with the lower bound indicating a potential meaningful decrease in risk-taking with age, though the upper bound crossing zero suggests some inconsistency across different age groups.

Using a generalized linear mixed model (GLMM), we further explored the effects of age, social context (individual vs. group decision-making), and task characteristics on risk-taking behaviors. Our analysis revealed significant main effects for both social context ($\chi^2(1) = 78.203$, $p < 2.2e-16$) and task condition variables ($\chi^2(1) = 140.558$, $p < 2.2e-16$), indicating that both the social environment and the nature of the task significantly impacted participants' risk-taking.

A key finding was the influence of the expected value of the risky option, which significantly affected decision-making ($\chi^2(1) = 402.16, p < 2.2e-16$). As the expected reward of the risky option increased, participants were more likely to engage in risk-taking behaviors. This relationship is consistent with economic theories of decision-making under uncertainty, where individuals assess potential rewards before opting for riskier choices. However, when the variance or uncertainty of the risky option increased, participants exhibited greater caution. This was particularly evident among adolescents, who appeared more sensitive to the variability in outcomes. The interaction between variance and age suggests that risk-averse behavior becomes more pronounced as uncertainty increases, especially in younger individuals.

Risk-Taking in Autonomous vs. Collective Decision-Making Contexts

Our analysis also examined the impact of social context on risk-taking behavior, revealing a negative trend in adolescents when making decisions in isolation. In the "alone" condition, a significant negative association between age and risk-taking was found (estimate = -0.062, $p = 0.002$), indicating that as adolescents grow older, they become less likely to take risks when making decisions individually (Fig. 7). This supports existing research, which suggests that risk-taking peaks during adolescence and declines into adulthood as cognitive control develops.

A comparative analysis of risk-taking in different social contexts revealed that participants in the "alone" condition took significantly fewer risks compared to those in the majority ("maj") group (estimate = -0.057, $p = 0.005$), highlighting the role of social influence. However, no significant differences were observed between the "alone" and minority ("min") group (estimate = -0.025, $p = 0.187$), indicating that group size and social influence may not uniformly affect risk-taking behavior across contexts (Fig. 7).

Further examination of risk-taking across different age groups revealed no significant age-related trends in the majority ("maj") group (estimate = -0.005, $p = 0.804$). However, in the minority ("min") group, a marginally significant negative trend was observed (estimate = -0.037, $p = 0.072$). This finding underscores the nuanced role that social context plays in shaping risk-taking behaviors across age groups. Adolescents appeared to behave differently depending on whether they were in majority or minority groups, pointing to the influence of peer dynamics and group size during this developmental stage.

The GLMM results further indicated that adolescents were more likely to shift from individual to collective decision-making after observing the outcomes of previous decisions. This shift was more pronounced in younger participants, while older individuals demonstrated a decreased preference for collective decision-making in the "alone" condition (coefficient = -0.035, SE = 0.018, $p = 0.063$). Although the confidence interval (-0.072 to 0.002) suggests some uncertainty, the overall trend indicates a decline in collective decision-making with age.

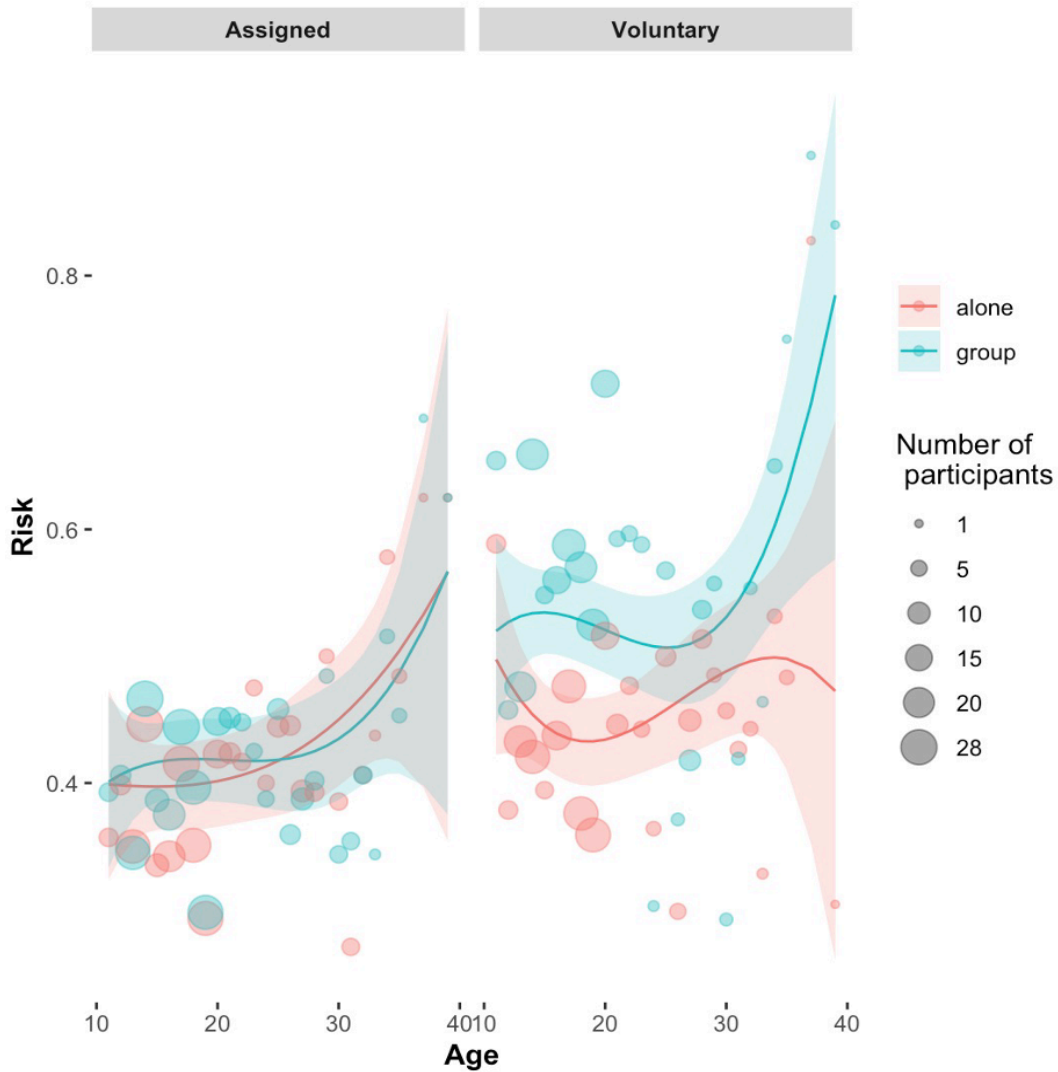
Collective Risk-Taking

A significant three-way interaction was identified between age, group condition, and decision-making context ($\chi^2(3) = 10.719$, $p = 0.013$), highlighting how social influences on risk-taking vary across different age groups. Adolescents demonstrated a higher likelihood of engaging in risky behaviors when making decisions collectively, particularly in voluntary group settings. Conversely, adults displayed more stable risk preferences across social contexts, showing less susceptibility to group dynamics. This suggests that social dynamics play a crucial role in adolescent decision-making, reinforcing the idea that adolescents are particularly sensitive to peer influence, especially in voluntary social environments.

When comparing these trends between alone and group conditions, a significant cubic contrast emerged in the voluntary context (estimate = -0.001, $p < 0.0001$), indicating that individuals making decisions in groups, compared to those alone, show a markedly different cubic age-related pattern of decision-making in voluntary settings. This suggests that the presence of a group significantly alters the more complex non-linear effects of age on decision-making in voluntary contexts (Fig. 6). By contrast, in the assigned context, there was no significant cubic contrast (estimate = -0.0002, $p = 0.315$), implying that age-related cubic trends in decision-making are relatively stable across social settings when individuals are not given a choice in their decision-making context.

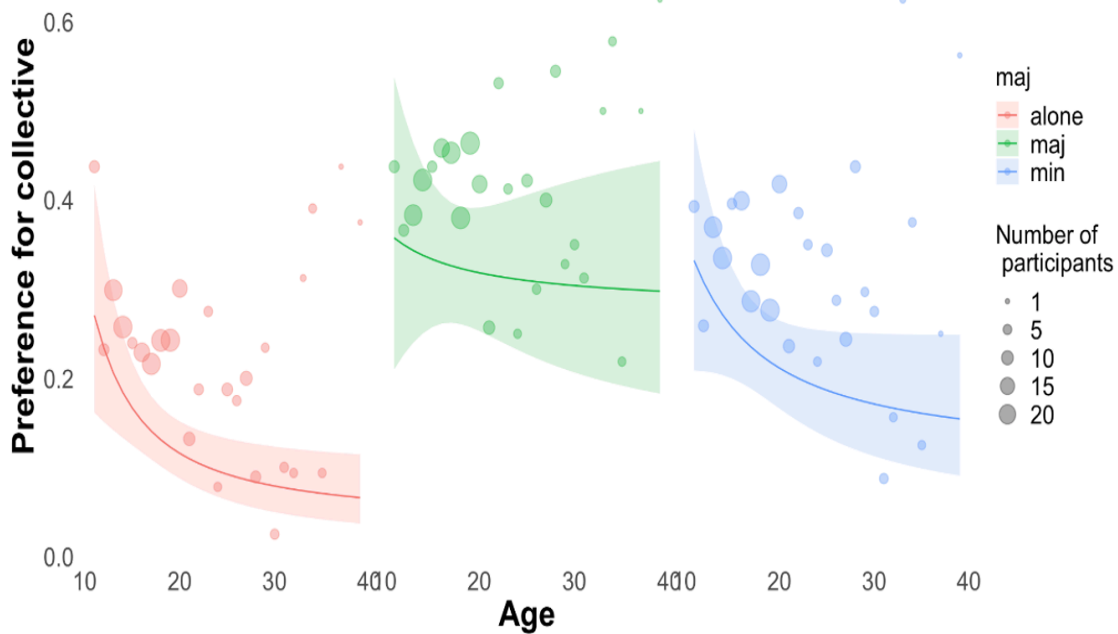
Summary of Findings

In summary, the results demonstrate a significant three-way interaction between age, group condition, and decision type, highlighting the complex relationships among these factors in risk-taking behavior. While all individuals showed sensitivity to the variance of risky options when deciding alone, this risk aversion was lessened in collective contexts, particularly among adolescents. The findings suggest that the presence of peers significantly influences decision-making processes during this developmental period, emphasizing the importance of both social context and the nature of group participation in shaping risk preferences. Overall, these results contribute to our understanding of how age and social dynamics interact to influence decision-making under risk, revealing the nuanced effects of voluntary versus assigned group contexts on risk-taking behavior.



(Fig 6 This figure illustrates risk-taking behavior as a function of (the cubic polynomial of) age, comparing autonomous vs. collective decision-making and whether this decision modality was assigned or voluntary. The solid lines represent estimated fixed effects from a generalized linear mixed model, with shaded ribbons indicating the 95% confidence intervals. Circles depict the mean risk-taking (versus safe choices) for each unique age in the dataset, highlighting how age influences risk preferences across different decision-making contexts.)

Age and Group Composition: Trends in Collective Preferences



(Fig.7 This scatter plot illustrates the relationship between age and preference for collective activities, with data points representing individuals who are alone (red), in the majority (green), or in the minority (blue). The size of each data point indicates the number of participants, ranging from 5 to 20. Shaded areas around the trend lines represent confidence intervals, highlighting the variability in preferences across different age groups and group compositions.)

DISCUSSION

This study aimed to investigate how collectives impact risk-taking differently in adolescents compared to adults, and how preferences for collective versus individual decision-making evolve throughout adolescence. Our findings reveal complex patterns of behavior across age groups and decision-making contexts, contributing valuable insights to the existing literature on adolescent development and decision-making.

Key Findings and Implications

Our first main finding was that voluntary collectives are more likely to take risks than individuals, with this effect being particularly amplified during mid to late adolescence. This result aligns with our hypothesis and extends previous research on collective risk-taking, suggesting that the social dynamics present in voluntary group settings may encourage greater risk-taking, especially among adolescents who are particularly susceptible to peer influence (Chein et al., 2011; Sawyer et al., 2018). This finding highlights the importance of considering both the voluntary nature of group formation and the developmental stage of the participants when studying adolescent decision-making.

Secondly, we found that after experiencing the outcomes of autonomous decisions, the likelihood of voluntarily joining a collective decreases as adolescents get older. This trend supports our hypothesis about the development of decision-making preferences and provides new insights into how adolescents learn from individual experiences to inform their future choices about group participation. These findings underline the complex interplay between age, social context, and decision-making, emphasizing the importance of considering both individual developmental trajectories and group dynamics when studying risk-taking behaviors.

Interestingly, our study yielded some unexpected results. A cubic association with age in risk-taking behavior emerged, suggesting a more complex developmental trajectory than previously thought. This non-linear pattern indicates that the relationship between age and risk-taking is not straightforward and may involve multiple inflection points throughout adolescence and early adulthood. However, this finding should be interpreted cautiously due to the limited number of older participants in our sample, which resulted in relatively low statistical power for this age group.

Furthermore, we only observed group effects on risk-taking in voluntary conditions, which does not fully replicate previous findings by Lloyd, Sutter, and Glatzle-Rutzler. This discrepancy could be due to differences in task complexity or the specific aspects of decision-making being measured. For instance, Lloyd's study found group effects only in ambiguous decisions, not risky ones, while the other studies focused on myopic loss aversion rather than risk-taking per se. Our results suggest that the voluntary nature of group formation may be a crucial factor in collective risk-taking, which has not been extensively explored in previous research.

Regarding preferences for collective decision-making, we found that age only decreased preferences for collectives after participants experienced outcomes alone, contrary to our expectation of a general decrease across conditions. Interestingly, in majority conditions, age had no effect on preferences for collective decision-making. This unexpected finding might be explained by research suggesting that adults are more likely than adolescents to expect others to agree with them. Additionally, learning that others share one's preferences has been associated with reward processing (El Zein et al., 2019). In majority conditions, where participants discover

their choice aligned with the group, adults may find this more rewarding than adolescents do, potentially leading them to continue joining collectives and flattening the age trend in these conditions.

Addressing Gaps in Literature and Future Research

The thesis identifies the gaps in the existing literature, particularly regarding the evolution of collective decision-making preferences from adolescence into adulthood. The insights gained from this study have practical implications for not only parents but also educators, and policymakers. Acknowledging the critical impact of peer influence on adolescent decision-making across different contexts enables policymakers to design targeted programs that foster positive peer interactions and encourage healthy risk-taking behaviors. For instance, school-based interventions that emphasize teamwork and collaborative decision-making can help adolescents navigate social dynamics while making well-informed decisions.

Future research should prioritize longitudinal studies that track changes in decision-making processes over time, offering a more comprehensive understanding of how these preferences emerge and develop. Furthermore, comparative studies exploring collective decision-making across diverse cultural contexts are crucial for deepening our understanding of how cultural values influence risk-taking behaviors and peer dynamics.

Additionally, the research emphasizes the importance of neurobiological factors in decision-making. The ongoing maturation of the prefrontal cortex during adolescence is critical for higher-order cognitive functions, including impulse control and emotional regulation (Pfeifer & Allen, 2021; Spear, 2009). Future studies should investigate how variations in

neurodevelopmental trajectories impact decision-making and risk-taking behaviors, particularly concerning peer influence.

Lastly, incorporating the impact of social media on risk-taking decisions could provide valuable insights into contemporary behaviors, particularly among adolescents. Given the pervasive nature of social media, it would be interesting to investigate how online interactions influence risk-taking compared to in-person behaviors. For instance, future research could explore whether the anonymity and distance provided by social media platforms lead to different risks than those observed in face-to-face settings. It may also be beneficial to assess whether certain types of social media content—such as risky challenges or peer endorsements—have a more pronounced effect on decision-making compared to traditional social interactions. Understanding these dynamics could enhance our comprehension of adolescent behavior in the digital age and inform strategies for promoting safer decision-making practices.

Conclusion

In summary, this thesis contributes to a deeper understanding of the relationship between collective decision-making and risk-taking behaviors in adolescents and young adults. By highlighting the influence of peer dynamics and the developmental shifts that occur during this critical developmental period, the study emphasizes the importance of supporting healthy decision-making processes. Addressing the gaps identified in the literature will pave the way for future studies that can further clarify the complexities of adolescent development and guide the development of effective interventions. As adolescents face the challenges of growing up, fostering environments that encourage positive peer interactions and informed decision-making will be essential for their overall health and success.

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