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Economic behavior of children and adolescents – A first survey of experimental economics results

Matthias Sutter[a,b,*], Claudia Zoller[a], Daniela Glätzle-Rützler[b]

[a] Max Planck Institute for Research on Collective Goods, Bonn, and University of Cologne, Germany
[b] University of Innsbruck, Austria

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ABSTRACT

About 15 years ago, economic experiments with children and adolescents were considered as an extravagant niche of economic research. Since then, this type of research has exploded in scope and depth. It has become clear that studying the development of economic behavior and its determinants is important to understand economic behavior of adults and to provide a basis for potential policy interventions with respect to economic behavior in childhood and adolescence. Given the huge increase of papers, we provide the first overview of economic experiments with children and adolescents. We focus on the following aspects: rationality of choices, risk preferences, time preferences, social preferences, cooperation, and competitiveness. All of these aspects are analyzed with respect to the influence of age and gender, and we also consider the role of socio-economic status or interventions.

1. Introduction

In the late 1990s, Bill Harbaugh, Kate Krause and co-authors pioneered what has become a very lively field of research since then, namely the experimental study of economic behavior by children and adolescents. Their early work has set examples of how to run experiments with children and adolescents and which topics can be studied with young experimental subjects, covering, among others, risk taking, social preferences, rationality of choices, or bargaining (Harbaugh and Krause, 2000; Harbaugh et al., 2001, 2002, 2003a, 2003b, 2007). While in the early years after their seminal contributions the number of experimental papers with children was still fairly small and it was easy to keep track of the whole literature, in the past ten years the number of experimental papers has flourished tremendously, if not to say that it has exploded. For this reason, we think it is time to write a first survey of the main topics in this field of research in experimental economics.[1] Given the explosion of papers, this survey will not be able to mention all of them, and possibly we have overlooked some

* Corresponding author.
E-mail address: matthias.sutter@coll.mpg.de (M. Sutter).

[1] Please note that this survey focuses primarily on studies conducted in the field of experimental economics, aiming to give a detailed insight into economic research conducted with children. Literature in the field of psychology discussing experimental settings with children will not be the main focus (see e.g., Warneken, 2018 for a survey on psychology literature on cooperation in children).

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papers, but it will try to organize the literature along different dimensions of economic behavior, and present the general pattern of results that one can see from reading the literature. In doing so, we will address children's and adolescents' (i) rationality of choices, (ii) time preferences, (iii) risk preferences, (iv) social preferences, including allocation games, bargaining games and games of cooperation, and (v) competitiveness. We will put the main emphasis in each dimension on the influence of age (typically from 3 year-olds to 18 year-olds) and gender on economic decisions of children and adolescents. On top of that, we consider further determinants of economic behavior, such as socio-economic status of parents, or the social context of interaction (like in-group/out-group scenarios). The selection of the aforementioned determinants of economic preferences is based on the fact that these are the most common studied predictors of children's economic behavior. Moreover, we will briefly address very recent studies that have run policy interventions to influence children's and adolescents' economic behavior. The latter type of studies rests on the knowledge of how economic behavior of children and adolescents looks and how it develops with age, for which reason this survey puts most weight on a descriptive analysis of children's and adolescents' economic behavior.

In the early years of experimental research with children and adolescents, editors and referees were often skeptical as to what could or should be learned from examining the economic behavior of children and adolescents.[2] Today, this type of research seems to be accepted as an established research field, also at the top journals, for a variety of reasons. First, studying behavior of children and adolescents can reveal whether economic behavior develops in characteristic patterns in the course of life. Similar to psychological research on the development of moral judgments, for instance, economic research is interested in whether fairness preferences, risk attitudes, impatience, rational choice behavior or competitive preferences develop in certain ways. Most behavioral models of social preferences, for instance (see, e.g., Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002), have been based on experimental evidence from university students in their early 20s. Research with children and adolescents can reveal whether such models (of non-standard preferences) also apply to pre-adulthood or whether the behavioral patterns of adults are the consequence of a directional development with age. Knowing more about such a potential development is a precondition for possible policy interventions that might try to promote particular types of behavior (such as patience with respect to attaining education, or avoiding conflicts through a mutual understanding of fairness and social norms). Second, from the viewpoint of economic theory it is interesting to study whether children and adolescents are sophisticated decision makers that make rational decisions and are capable of applying fundamental game theoretic concepts (such as backward induction or mixed strategy play) in their behavior. This would mean that such fundamental concepts are useful also to describe (at least parts) of young children's and adolescents' behavior. Third, and related to the first reason, the study of economic behavior of children and teenagers has gained importance through the research program of researchers like James Heckman who have studied how non-cognitive skills influence subjects' academic attainment, social and economic success, in particular on labor markets, or their health (Heckman, 2006; Heckman and Rubinstein, 2001; Heckman et al., 2006; Kautz et al., 2014). As non-cognitive skills develop dynamically, early childhood programs and interventions aiming at improving non-cognitive skills have proven efficient and beneficial for lifetime outcomes (Heckman, 2006; Kautz et al., 2014). Hence, improving our knowledge of economic preferences as an important subset of non-cognitive skills contributes to this strand of literature in the tradition of Heckman.

Of course, experimental research with children and adolescents sometimes differs in procedural and design details from experimental research with adults. For example, with pre-school children, it is typically impossible to use money as incentives. Rather, children can earn tokens that may be exchanged for small presents (like stickers, candies or toys) in an experimental shop after an experiment. Salience of rewards is often ensured by showing children the presents before commencement of the experiment (see, e.g., Harbaugh and Krause, 2000). Experiments are usually conducted in a controlled setting in schools or day-care centers, minimizing self-selection effects (see, e.g., Harbaugh et al., 2003a; Sutter et al., 2013b). To ensure understanding and full attention experiments with very young children are conducted in a one-on-one setting where an experimenter explains to a single child the rules of the experiment, rather than explaining everything in front of a whole group of participants (see, e.g., Fehr et al., 2008). In general, economic experiments with children and adolescents, despite the aforementioned differences to experiments with adults, have become more and more standardized over the past 10 years, and this standardization is important for making the research better comparable. For instance, it is customary nowadays to check for correct understanding by adding control questions about comprehension or to preserve anonymity by the use of sliding walls (and by paying with sealed envelopes or handing over presents in opaque bags). Careful attention is also paid to avoid spreading information about the experiment among subjects who have not yet participated in it (which is sometimes not easy in schools or kindergarten). Most importantly, the standardization of the conduct of experiments has become much more advanced, for example by extensive training of experimental helpers to use the same wording and sequence of explanations when explaining experimental rules to children. Recently, Schunk et al. (2017) or Hermes et al. (2018) have gone one important step further in this respect. They ensure comprehension with the support of animated visual- and audio-aids. More precisely, they use tablets and headphones to ensure identical delivery of instructions to children which is a further advance in standardization. Despite these improvements in methodology, the studies presented in this survey differ here and there in design or procedural details, which means, for example, that cooperation rates in a prisoner's dilemma depend on the exact parameters. For this reason we are not going into the details of the quantitative

[2] In the early 2000s, the first author of this survey got editorial decision letters that called experiments with children exotic research that would not help the scientific community in economics to better understand how markets work, for which reason the editors recommended to look for outlets in psychology.

results of the papers discussed here, but rather we focus on qualitative patterns of behavior across different studies. There is a highly recommended companion paper by List et al. (2018) that asks how experiments with children can inform economics and that presents a state-of-the-art overview about the different methods – and its pros and cons – to run economic experiments with children and adolescents. The interested reader is referred to this paper for details. In our survey here we focus on the main results of experimental studies with children and adolescents.

In each section, we start the survey by presenting the main results with respect to the influence of age and gender on economic preferences of children and adolescents. In most sections, we will also refer to the relation of socio-economic status (SES) of parents to economic preferences of their offspring. Finally, in some sections we are also going to look at additional factors, like cognitive factors, in-group favoritism, or policy interventions, that are discussed in the literature as potentially affecting the economic behavior of children and adolescents.

By and large, the literature reveals the following pattern of the relationship of age and economic preferences.[3] In early childhood, children are relatively self-centered with respect to social preferences, impatient, and risk tolerant. Only when getting older, in particular in adolescence, subjects' social preferences shift towards egalitarian and more efficiency-oriented behavior, and subjects become relatively more patient and more risk averse than in early childhood. With increasing age, parochialism becomes more pronounced as well as subjects favor more often members of their own social group. With respect to gender, we note large differences in competitiveness and risk taking, but less clear-cut differences in other behavioral domains. With respect to social preferences, girls tend to make more altruistic, cooperative, and inequality averse choices while boys are more concerned with efficiency and tend to be more selfish. Concerning socio-economic status (SES) of parents, it seems that children from a low SES-background are often less patient, less pro-social and less competitive than children from higher SES-backgrounds.

In the following, we present more details on economic behavior in childhood and adolescence in separate sections for different behavioral categories and preferences.[4] We start our survey with a brief section on the rationality of children's economic choices. This section is motivated to address the (unwarranted) concern that economic choices of children and adolescents might be random and would therefore contain no systematic insights. Section 2 will show that this is not the case, thus lending support that we can draw meaningful conclusions when looking at different preferences and behavioral patterns. Section 3 is devoted to time preferences, and Section 4 to risk preferences. The Sections 5, 6, and 7 shed light on social preferences, once from individual allocations tasks (Section 5), once with respect to bargaining games (Section 6), and once from games of cooperation (Section 7). Section 8 deals with competitiveness. Finally, Section 9 concludes the survey with a short summary and a discussion of open questions and an outlook about promising further avenues for experimental economics research with children and adolescents.

2. Rationality of children's choices

Harbaugh et al. (2001) have been the first to show that already at an early age children are able to make decisions according to basic requirements of rationality. In their experiment with 7 and 11-year-olds, children of both age groups have to choose among different bundles to check whether their choices obey the generalized axiom of revealed preferences (GARP). It turns out that even the younger children are doing better than chance. Yet, it is true that the number of preference violations decreases with age. For instance, only 25% of 7-year-olds, but 60% of 11-year-olds make choices that are consistent with utility maximization. Compared to an adult subject pool there is no increase in the rationality of choices between the ages of 11 and 21, showing that rational behavior is prevalent already during adolescence and comparable to the level of adults.

In addition to making rational choices, the ability to form reasonable beliefs and make correct inferences further plays an important role in economic decision-making. Barash et al. (2018) let children draw from an urn with different compositions of colored balls in order to study the updating of beliefs. Younger children (aged 6–8) make decisions based on the previous outcome, using heuristics to determine their next move. With increasing age children and young adolescents start to take the entire series of draws into consideration, but frequently fall prey to the gambler's fallacy. From age 15 onwards, adolescents increasingly play a Bayesian strategy, in line with behavior shown by adults. Children hence move closer to behaving rationally as they grow older (Barash et al., 2018). Similarly, Brocas and Carrillo (2018a) let children make choices (in a non-interactive version of the game "Connect 4") and check whether they are able to think ahead a few moves. Similar to Barash et al. (2018), they find that older children are better in anticipating future moves and thus to reason in a more sophisticated way. Apesteguia et al. (2018) study imitation of successful choices of others in children (aged 8–10) and adults (university students). They let their subjects repeatedly (over 10 rounds) choose to draw a ball from six different urns with different payoffs. In the baseline treatment subjects are not able to observe other participants while in the observation treatment subjects observe the outcome of a draw of another subject. The analysis of the baseline treatment reveals that all subjects

[3] When we talk about developments with age, we refer to cross-sectional evidence from cohorts of different age. Too few studies have a panel structure that could speak to a within-subject development of economic behavior with increasing age.

[4] In each section, we concentrate on papers whose main research question addresses that section's preference. When a paper uses that section's preference only as a control variable to investigate yet another preference, we do not discuss such a paper in that section. To illustrate the procedure with an example: Studies on children's competitiveness often include a measurement of risk attitudes as a control variable to explain competitiveness. We are not going to include such papers in the section on risk preferences.

are able to learn across rounds. However, adults have a steeper learning curve than children. Results from the observation treatment indicate that children, unlike adults, are not able to take advantage of the additional information received by observing others, meaning that they do not engage in rational imitation.

Strategic sophistication is another fundamental requisite of economic decision-making in interactive contexts. Being able to anticipate an interaction partner's rationality and incentives is crucial for success in strategic interactions. Brocas and Carrillo (2018b) study two-person games with 4–7-year-olds where the games are characterized by different levels of iterative complexity, i.e., the number of iterations before reaching the equilibrium of the game. They find that older children in their sample are significantly more likely to reach the equilibrium, but it is reassuring to note that younger children can also play equilibrium strategies when the iterative dominance is not too demanding. While Brocas and Carrillo (2018b) notice an age trend in the degree of strategic sophistication for 4–7-year-olds, Czermak et al. (2016) find hardly any changes in strategic sophistication in 10–17-year-olds. They let adolescents play two-person normal form games with different degrees of iterated dominance. Only with respect to the likelihood of eliminating dominated strategies, they observe older adolescents to have a higher likelihood, but all age groups are equally likely to reach the efficient (non-equilibrium) outcome of the normal form games. Moreover, the estimation of strategic types reveals no age differences either, and the distribution of types is similar to adult university students (Sutter et al., 2013a). Related to the concept of strategic sophistication is the ability to apply backward induction. Again, this ability seems to increase with age. Brosig-Koch et al. (2015) examine how children aged 6–15 play so-called race games in which two players can move sequentially in choosing numbers (in a predefined interval) until a pre-specified number is reached. These games can be solved by backward induction, and first movers have an advantage. They find that first graders of age 6 perform significantly worse than older children, but that the differences across age diminish as subjects reach middle adolescence.

Neither rational decision making nor strategic reasoning differs significantly by gender for most ages. In early childhood females play equilibrium at higher rates than their male counterparts (Brocas and Carrillo, 2018b), while boys are better able to do backwards reasoning than girls until early adolescence, which is when the gender gap closes (Brosig-Koch et al., 2015; Czermak et al., 2016).

Cognitive ability affects the extent of rational choice and strategic behavior displayed by adolescents. A better math grade positively correlates with higher strategic sophistication and more rational choices, ultimately leading to higher payoffs in the experimental games (Brosig-Koch et al., 2015; Czermak et al., 2016; Harbaugh et al., 2001). Similarly, children who are assessed by their teachers as suitable for "Gymnasium" (the higher track in the Austrian school system) are shown to have a steeper learning curve than those predicted not to reach the "Gymnasium" (Apesteguia et al., 2018).

Summary rationality of choices. Already young children show rational behavior to a considerable extent, obeying the laws of transitivity, and making (often) correct inferences about the partner's rationality, and applying strategic reasoning in choosing their strategy in interactive games. All of these skills develop and become more pronounced from childhood to adolescence, implying that adolescents' behavior assimilates more and more towards behavior observed in adults. Hence, children and adolescents do not make decisions randomly but are able to take strategic considerations and basic principles of rational behavior into account when making economic decisions, thus gradually reaching the behavioral patterns observed in adult subject pools (Table 1).

3. Time preferences

Time preferences are typically measured by letting subjects choose between a sooner, but smaller payment, and a larger, but later payment. Hence, they are a measure of how the present and the future (or the nearer and the more distant future) are traded off. Most studies find that children and adolescents become more patient as they grow older – i.e., they choose more often the larger, but later reward instead of a smaller, but sooner reward. In other words, older subjects are more likely to delay gratification to a later point in time. This pattern starts already at pre-school or kindergarten age, as Sutter et al. (2015) have found for 3–6-year-olds who had to choose between one small present today and two small presents tomorrow (see also Lemmon and Moore, 2007). Bettinger and Slonim (2007) also report that older children in their sample of 5–16-year-olds are more likely to wait for larger rewards in the future. They estimate that one additional year of age makes subjects about 2% more likely to be patient and choose the larger reward in the future. The method to elicit time preferences does not seem to matter, as Angerer et al. (2015b) show. They compare a simple choice list – where subjects choose between either a specific amount at an earlier point in time or a larger amount at a later date – with the elicitation method based on Andreoni and Sprenger (2012), called a convex budget set where subjects can allocate a specific amount between earlier and later points in time (and allocations to later points in time are more valuable). Both methods produce very similar results in a set of 7–11 year-old children, with older children being more patient with both methods. Using a similar age cohort of 7–10-year-olds, Deckers et al. (2015) also find older subjects to choose more often the larger, but later rewards. Only for teenagers, Sutter et al. (2013b) fail to find a positive influence of age on the likelihood to delay gratification, but rather age is insignificant there for 10–18-year-olds.

While age is predominantly positively related to patience, the evidence with respect to gender is very mixed and all over the place. The earliest study of Bettinger and Slonim (2007) finds boys to be less patient than girls, and Castillo et al. (2011) report the same pattern. However, Golsteyn et al. (2014) and Deckers et al. (2015) show the opposite, namely that girls are less patient than boys. Other studies, like Lührmann et al. (2018) and Sutter et al. (2013b) in their studies with

Table 1
Rationality of children's choices

Authors	Subject Pool			Experimental Task	Results			
	Age	Sample size	Country		Age	Gender	SES	Other
Harbaugh et al. (2001)	7 & 11	73	U.S.	Choice sets	With age number of violations decreases			
Brosig-Koch et al. (2015)	6–15	120	GER	Race game	With age performance increases	Young females perform worse		
Czermak et al. (2016)	10–17	191	AUT	Normal form games	With age elimination of dominated strategies	Females better at detecting dominated strategies		
Apesteguia et al. (2018)	8–10	82	AUT	Urn draw	With age rational imitation develops, learning curve gets steeper			Learning curve steeper for children with higher cognitive ability
Barash et al. (2018)	6–18	334	U.S.	Urn draw	Younger children use heuristics, older children (wrong) inferences			
Brocas and Carrillo (2018a)	4–5	72	U.S.	Tasks to elicit anticipatory reasoning and logical reasoning	With age increase in strategic thinking			
Brocas and Carrillo (2018b)	4–7	122	U.S.	Matching, fighting, tower, shape game	With age increase in strategic play	Females play equilibrium at higher rates		

teenagers or Sutter et al. (2015) with kindergarten children, indicate no significant gender differences, or only under very specific conditions (like in Sutter et al., 2013b where they show weak evidence of females being more patient only in a high stakes condition with no up-front delay).

Aside from the influence of age and gender, a few design parameters have expected effects. Children and adolescents react to larger stake sizes and to shorter waiting times (for the larger, but later reward) by making more patient choices (i.e., waiting more often). This means that prices and the duration of waiting influence behavior in a predictable way. Bettinger and Slonim (2007) find evidence for hyperbolic discounting of children and adolescents, meaning that if there is a positive upfront delay for the smaller, but sooner, reward it is more likely that subjects wait for the larger, but later reward (keeping the waiting time constant, of course).

Family background also matters. Typically, more patient parents have more patient children which speaks in favor of an intergenerational transmission of this preference (Kosse and Pfeiffer, 2012). Children from low SES families have been observed to make substantially more impatient choices compared to children from medium or high SES backgrounds (Deckers et al., 2017). Regarding ethnicity, Castillo et al. (2011) not only find black children to be more impatient, but this result to be especially pronounced for black boys. The discount rate of black boys is on average 14 percentage points larger than that of black girls or white boys.

Experimentally elicited time preferences have been found to be correlated to important field behavior, such as health or educational outcomes. A one standard deviation increase in the discount rate increases disciplinary referrals in schools by 14% in Castillo et al.'s (2011) sample of 9th graders. In a follow up, Castillo et al. (2018b) even find that time preferences are a good predictor of dropping out of high-school or finishing it. Given that disciplinary referrals in school or becoming a dropout are good indicators for later outcomes in educational attainment or labor market success (Segal, 2013), time preferences of adolescents are related to later labor market outcomes. Subjects who are more patient in time preference experiments are also more likely to save money from their available weekly allowance (Benjamin et al., 2013; Lührmann et al., 2018; Sutter et al., 2013b). Concerning health related behavior, higher levels of impatience in children and adolescents are a significant indicator of spending more money on health endangering activities such as smoking or alcohol consumption (Sutter et al., 2013b).

Given the importance of time preferences for field behavior, recent studies have started to investigate whether and how policy interventions might affect children's and adolescents' time preferences such that they might foster patience. Most notably, Alan and Ertac (2018a) have implemented an educational intervention promoting forward-looking behavior and patience in 9–10-year-old children in Turkish schools. The students have been exposed to a curricular intervention for several weeks, during which they have encountered various scenario techniques to imagine the trade-off between present and future. Treated students demand on average about 25% smaller rewards for a one week delay of gratification, compared to a control group. The effect is especially pronounced for previously present-biased students who reduce their demand by about 50%. Delay sensitivity also increases in 15-year-olds after an intervention on enhancing financial literacy in German schools (Lührmann et al., 2018).

Summary time preferences. Patience increases typically with age, as older children and adolescents are typically more likely than younger ones to choose a larger, but later reward instead of smaller, but sooner reward. So far, the literature has not produced a clear-cut result on possible gender differences as results are all over the place, sometimes finding girls to be more patient, sometimes boys, and sometimes reporting no difference at all. Socio-economic status of parents is related to children's and adolescents' time preferences as a low SES-background is related to more impatient choices. Importantly, it has been shown that experimentally elicited time preferences are correlated with important field behavior, such as health or educational outcomes. Finally, patience seems to be a malleable skill as interventions can have a positive impact on more forward-looking behavior (Table 2).

4. Risk preferences

Risk preferences are most of the time measured by letting subjects decide between a safe amount of money (or a non-monetary reward) and a lottery that pays either a higher or lower amount than the safe alternative. Sometimes, risk preferences are also measured by giving subjects a fixed endowment and letting them decide which part of it to invest into a lottery that has typically a positive expected value (Charness and Gneezy, 2010). Experimental studies with children and adolescents have elicited risk preferences for a wide age spectrum, ranging from kindergarten to the late teenage years. Harbaugh et al. (2002) seminal study let children and adolescents choose between a risky gamble and a safe outcome. They report that the probability of choosing the risky gamble decreases in adolescents compared to younger children (especially in the loss domain). The propensity to choose the gamble over the safe payoff increases with the probability of a win and decreases with a higher probability of a loss in their sample of 5–20-year-olds. Harbaugh et al. (2002) conclude that children's choices are consistent with the use of subjective probability weights which decrease as children get older, gradually reaching objective probability weighting in early adulthood. Deckers et al. (2015) also find that the willingness to seek risk is getting smaller with increasing age, covering an age range from 7 to 10 years. Yet, for adolescents, there is less evidence for an age effect. In fact, Sutter et al. (2013b) find no age effects on risk taking in their set of 10–18-year-olds, nor do Eckel et al. (2012) for 15–17-year-olds and Munro and Tanaka (2014) for 12–18-year-olds. This suggests that changes in risk preferences might occur before the teenage years, with children becoming less risk seeking until they reach teenager age.

Table 2
Time preferences

Authors	Subject Pool			Experimental Task	Results			
	Age	Sample size	Country		Age	Gender	SES	Other
Bettinger and Slonim (2007)	5–16	191	U.S.	Binary choice set	With age patience increases	Females more patient		
Castillo et al. (2011)	13–14	878	U.S.	Binary choice set		Females more patient	Black children less patient	Impatience correlates with disciplinary referrals
Kosse and Pfeiffer (2012)	Preschool age	213	GER	Choice task				Mother's and child's impatience are correlated
Golsteyn et al. (2014)	13	11,907	SWE	Choice task		Females less patient		Patience positively correlated with higher grades, attaining university diploma, higher earnings
Sutter et al. (2013b)	10–18	661	AUT	Binary choice set		Females more patient if high stakes and no up-front delay		Impatient children more likely to spend money on smoking, alcohol, have more conduct referrals, less likely to save money
Angerer et al. (2015b)	7–11	561	IT	Binary choice list & time investment exercise	With age patience increases	Females less patient in CL		Both measures yield similar results
Deckers et al. (2015)	7–10	732	GER	Piggy bank	With age patience increases	Females less patient	Low SES less patient	
Sutter et al. (2015)	3–6	336	AUT	Allocate tokens to envelopes	With age patience increases			Changing the default option increases patience
Deckers et al. (2017)	7–9	435	GER	Piggy bank			Low SES less patient	
Alan and Ertac (2018a)	9–10	1,921	TUR	Binary choice set & convex time budget				Students in intervention demanded 22-32% fewer presents for one week wait; treated students less likely to receive low "behavioral grade"
Castillo et al. (2018b)	13–15	878	U.S.	Binary choice set		Females more patient		More impatient children are less likley to graduate from high school
Lührmann et al. (2018)	13–15	914	GER	Convex time budget				Patience positively correlates with higher math grades and cognition scores

Table 3
Risk preferences

Authors	Subject Pool			Experimental Task	Results			
	Age	Sample size	Country		Age	Gender	SES	Other
Harbaugh et al. (2002)	5–20	187	U.S.	Safe option vs. gamble	With age less risk seeking			
Levin and Hart (2003)	5–8	102	U.S.	Safe option vs. gamble		Females more risk averse (only for losses)		Parent's total number of risky choices positively related to child's
Borghans et al. (2009)	15–16	347	NL	Ellsberg two-color choice task		Females more risk averse		
Moreira et al. (2010)	4–6	100	BRA	Safe option vs. gamble		Females more risk averse		
Booth and Nolen (2012b)	15	260	U.K.	Safe option vs. gamble		Females more risk averse		Females from same-sex schools just as likely to enter lottery as males; being in an all-girl-group makes females less risk averse
Cárdenas et al. (2012)	9–12	1,200	SWE & COL	Choice of six gambles and safe option		Females more risk averse		Competing and risk taking are correlated for Swedish children and Columbian males
Eckel et al. (2012)	14–15 & 16–17	490	U.S	Choice out of six gambles		Females more risk averse	Low income peers reduce risk tolerance	
Tymula et al. (2012)	12–17	33	U.S.	Safe option vs. gamble	Adolescents more risk averse than adults			
Sutter et al. (2013b)	10–18	661	AUT	Ellsberg two-color choice task		Females more risk averse		
Munro and Tanaka (2014)	12–18	412	UGA	Holt-Laury pair wise choice framework				71% of children have lower risk aversion than their parents
Alan et al. (2015)	7–9	746	TUR	Gneezy & Potters risk elicitation task	Older males invest more	Females more risk averse	Low SES females invest more	Child's risk taking correlates positively with mother's risk taking
Deckers et al. (2015)	7–10	732	GER	Safe option vs. gamble	With age less risk seeking	Females more risk averse	Low SES more risk seeking	
Glätzle-Rützler et al. (2015)	11–18	755	AUT	Investment in lottery	Increase in investments between 10^{th} and 12^{th} graders	Females invest less		No evidence of myopic loss aversion
Khachatryan et al. (2015)	7–16	824	ARM	Safe option vs. gamble	With age males become more risk seeking	Females more risk averse		
Castillo (2017)	5 & 8	2,000	PER	Choice of six gambles		Females more risk averse		Domestic violence correlates with risk averse decisions
Deckers et al. (2017)	7–9	435	GER	Safe option vs. gamble			Low SES more risk seeking	
Castillo et al. (2018a)	13–14	1,275	U.S.	Choice between two lotteries				Children who are more risk averse are less likely to receive disciplinary referrals, and more likely to complete high school

Regarding gender differences in risk preferences, there is strong evidence of girls being significantly more risk averse than boys (Alan et al., 2017; Booth and Nolen, 2012b; Borghans et al., 2009; Cárdenas et al., 2012; Castillo, 2017; Deckers et al., 2015; Eckel et al., 2012; Glätzle-Rützler et al., 2015; Khachatryan et al., 2015; Levin and Hart, 2003; Moreira et al., 2010; Sutter et al., 2013b). This pattern reflects the common knowledge of adult women being, in general, more risk averse than adult men (Croson and Gneezy, 2009). The evidence for children and adolescents ranges from very early childhood, starting at 4 years of age, all the way through adolescence, and it also stems from many different regions of the world and cultures. One example for the latter type of work is presented by Cárdenas et al. (2012) who compare two samples of 9–12 year-old subjects in Columbia and Sweden. In their risk task, children can choose between a lottery that yields 0 or 10 points with equal probability, or choose a safe amount that varies between 2 and 7.5 points. In both countries, boys have a certainty equivalent of the lottery of about 4.5 points. Also, in both countries, girls are significantly more risk averse, but the gender differences are much more pronounced in Columbia (with girls' certainty equivalent around 3.2 points) than in Sweden (certainty equivalent around 3.8 points for girls). This evidence suggests that there might be an interaction of gender and culture in the willingness to take risks. Booth and Nolen (2012b) point towards another potential interaction effect by studying how the gender composition in school might affect gender differences in risk taking. They examine risk taking in single-sex and in co-education schools. Girls in co-education schools are 36% less likely to choose a risky lottery while there is no difference in the likelihood to take risks between boys and girls from single-sex schools. The authors argue that the environment significantly affects the propensity to take risks as female-only groups in the experiment induced more moderate risk taking in girls (irrespective of their school composition). However, Booth and Nolen (2012b) also discuss the possibility of self-selection effects into single-sex or co-education schools.

Several papers examine the transmission of risk preferences from parents to their children and observe similar risk taking behavior within parent-child-pairs. A mother's willingness to invest in a lottery correlates significantly with her child's risk preferences. Especially mothers who are more involved in the child's upbringing have a closely related risk tolerance to that of their daughters, as Alan et al. (2017) find in their sample of 7–9-year-olds. This connection of similar risk taking propensities in parents and children is already prevalent in early childhood, as parents' and children's number of risky choices are positively correlated, even though overall children from age 5–8 are more risk seeking than their parents (Levin and Hart, 2003).

Family background also enters via SES as a determinant of children's risk taking. Low SES children are generally more risk taking. Deckers et al. (2017) find that effect size is 23% of a standard deviation, compared to medium and high SES children. This difference by socio-economic status decreases with age and the effect diminishes around age 10 (Deckers et al., 2015). Low socio-economic status has an especially large effect on girls in Alan et al.'s (2017) sample, as girls in the lowest SES-quartile invested on average 14 percentage points more in a risky lottery. Castillo (2017) notes another important influence of family on risk taking. He shows that domestic violence in families affects children to be significantly more risk averse. A similar directional effect is observed by Eckel et al. (2012) who show that having low income peers (outside of the family) makes children more risk averse.

One other important factor that is often discussed in relation to risk preferences is cognitive abilities. Yet, here the literature has produced fairly divergent results. For instance, Benjamin et al. (2013) report high-school students with higher math grades to make more risk neutral choices. Eckel et al. (2012) and Sutter et al. (2013b), however, do not find a correlation between math grades and risk taking. Alan et al. (2017) administer several tests of cognitive ability, but only one of them (inhibitory control) is associated with lower risk taking and then only in boys. Castillo (2017) fails to find any significant relationship of cognitive development in 5 and 8-year-olds and risky choices. Overall, the inconclusive pattern might be driven by design details and small differences, yet so far it seems unclear how cognitive abilities are related to risk taking of children and adolescents.

Experimentally elicited risk preferences have also been shown to relate to relevant field behavior. Castillo et al. (2018a) find that more risk averse adolescents are less likely to get disciplinary referrals in school and also less likely to drop out of high school.

Summary risk preferences. The overwhelming majority of studies find that girls are more risk averse (i.e., less risk tolerant) than boys, and this pattern persists across childhood and adolescence (and continues in adulthood). There appears to be an age trend as well, especially in childhood, as older children are less risk seeking or risk taking than younger children. This seems to be driven by subjective probability weights that change across age. Family background is important, as the risk preferences of parents are typically correlated to those of their offspring, but also as low socio-economic status of parents is associated with more (and sometimes excessive) risk taking. (Table 3)

5. Social preferences I: individual decision making

Broadly speaking, social preferences capture the different ways in which subjects consider own payoffs (or rewards) and others' payoffs. They capture standard preferences – that are often defined as subjects caring only for themselves and ignoring outcomes for others –, but also various forms of non-standard preferences which allow for positive (and in case of spite also negative) weights for others' outcomes in a subject's utility function. Social preferences play a role when subjects have to make allocation decisions in which they split up a pie among themselves and others, with others being powerless, but also when subjects interact in a strategic game with others, like in simple bargaining games or games of cooperation.

We start the survey about children's and adolescents' social preferences by looking at allocation tasks that are a form of individual decision making, void of any strategic interaction. In the following Sections 6 and 7 we will consider interactive games.

The most often used task to study social preferences of children and adolescents is the dictator game where a dictator is endowed with a fixed endowment and subsequently can distribute it between him- or herself and a powerless recipient. While it is commonly called a game, the dictator game is, in fact, an individual decision making task. A variant of the dictator game lets subjects choose between different allocations where the sum of money distributed in each allocation does not need to be constant across allocations.

The dictator game (and its variants) has been the most often used vehicle to study social preferences of children and adolescents. Concerning the influence of age, the evidence is pretty straightforward: the older subjects get, the more likely they are to transfer increasing parts of their endowment to the recipient. This is not to say that subjects become hyper-fair by offering more than 50% of their endowment, but older ones are less likely to be selfish by keeping the whole endowment for themselves and also give more often up to 50%. For instance, in Gummerum et al. (2010) study the modal offer of 3–4-year-olds is to keep everything for themselves, while 5–6-year-olds choose more often an equal split. Similar trends with very young children are found in List and Samek (2013), Ben-Ner et al. (2017) or Brocas et al. (2017), and for elementary school kids, aged 6 to around 10 or 11, it is also typically observed that older children are more generous towards the recipient (Bettinger and Slonim, 2006; Blake et al., 2015; Brocas et al., 2017; Chen et al., 2016; Deckers et al., 2015; Harbaugh et al., 2003a; Maggian and Villeval, 2016; Martinsson et al., 2011; Sutter et al., 2018).[5] This trend continues also into adolescence, where mean allocations to recipients increase with age and can reach levels of around 35% of the available endowment (Eckel et al., 2011; Harbaugh et al., 2003a; John and Thomsen, 2015), which is a high average compared to about 28% found in a meta-study of dictator games with adults (Engel, 2011).

A specific design invented by Fehr et al. (2008) allows to define different types of social preferences. The design consists of three "games" (again individual decision making tasks) in each of which a subject can choose among two options. One option is always an egalitarian outcome, while the alternatives differ in order to be able to classify the social preference type of a specific subject from the three choices made. While this classification has some limitations (see Bauer et al., 2014 for an explanation and extension), the three types for classification are the following: an egalitarian type who prefers the egalitarian options; a spiteful type who always minimizes the recipient's payoff; and an altruistic type that maximize the recipient's payoffs. The latter type is indistinguishable from an efficiency-maximizing type, however. Fehr et al. (2008) study 3–8-year-old children and find that egalitarian types, i.e., those with a strong aversion against inequality, become considerably more frequent from age 3 to age 8. Children at the age of 3–4 behave selfishly to a very large degree, whereas the majority of children aged 7–8 prefer egalitarian allocations that avoid both advantageous and disadvantageous inequality. More precisely, about 60% of 7–8-year-old children can be classified as having egalitarian preferences, while the corresponding share for 3–4-year-olds is only 20% (see also Bauer et al., 2014 for a similar pattern of age effects). In a follow-up, Fehr et al. (2013) show that egalitarian types peak at around age 8. Looking at 9–17-year-olds, they find that efficiency seeking becomes much more prevalent – at the expense of egalitarianism – with increasing age. Prior to the latter finding, Almås et al. (2010), have already shown that efficiency seeking becomes the most important social preference motive in adolescence. Yet, they have added an interesting twist by letting their dictators divide a pie of money that has been generated through a real effort task, executed by both the dictator and the recipient. This allows examining whether social preferences – i.e., sharing behavior – depend upon the effort invested by dictators and recipients to generate the pie in the first hand. When efforts – and thus the contribution to the pie – differ, 10–11-year-olds typically do not condition their allocation choices on the differences in effort levels. However, adolescents around age 15 do so, and they are predominantly meritocrats who accept unequal earnings if they are due to unequal effort provision. Most adolescents hence deem it fair that those who have exerted less effort deserve to earn less (Almås et al., 2017; 2010).

When it comes to the examination of gender differences in allocation choices, the predominant finding is that girls are more generous in classical dictator games and more likely to be of an egalitarian type in the Fehr et al. (2008) design (Angerer et al., 2017; 2015a; Bettinger and Slonim, 2006; Chen et al., 2016; Deckers et al., 2015; Fehr et al., 2013; Gummerum et al., 2010; Harbaugh et al., 2003a; Houser and Schunk, 2009; List and Samek, 2013; Maggian and Villeval, 2016; Martinsson et al., 2011). Boys are more likely to be efficiency seeking types that try to maximize the sum of payoffs when choosing between different allocations. If multiple options and recipients are available (as in designs based on Engelmann and Strobel, 2004), one can also see that girls can be classified more often as a maximin type that tries to maximize the minimum payoff in the set of people who are affected by a specific allocation (Sutter et al., 2018). Whereas such gender differences refer to the decision maker's gender, Houser and Schunk (2009) report also an influence of the gender of the recipient, as both genders share higher amounts when they are aware that the recipient is male.

Social preferences within families seem to be related between children and parents, although the relation is not always significant. Ben-Ner et al. (2017), for instance, find that the generosity of young children, aged 3–5, in a dictator game is related to parents' donation to a charity, but that the relation is significant only for firstborn children (who might be most strongly influenced by parents because parents could devote most time to their oldest offspring).

[5] Maggian and Villeval (2016) combine their dictator game with an option to lie about which allocation was randomly determined by a computer. They found that all children in their set of 7–17-year-olds have a strong aversion against lying (about 85% do not lie when it would potentially benefit them).

Table 4
Social preferences – Individual decision making

Authors	Subject Pool			Experimental Task	Results			
	Age	Sample size	Country		Age	Gender	SES	Other
Harbaugh et al. (2003b)	7–18	310	U.S.	UG, DG	Older children give more	Females give more		
Bettinger and Slonim (2006)	6–14	572	U.S.	DG	Older children give more	Females give more		Children give more to charity than peers
Fehr et al. (2008)	3–8	229	CH	DG, in/out-group	With age increase in egalitarian choices and parochialism	Females less parochial		
Houser and Schunk (2009)	8–10	151	GER	DG		Females give more		Competition decreases fairness in males but not females
Almås et al. (2010)	11–19	486	NOR	DG, spectator	With age increase in meritocratic and efficiency-based choices	Females less efficiency-based		
Gummerum et al. (2010)	3–5	77	U.K.	DG		Males more zero offers		
Eckel et al. (2011)	14–17	490	U.S.	DG				High norm conformance give and expect more
Martinsson et al. (2011)	10–15	650	AUT & SWE	DG	Older children less difference averse and more welfare concerned	Females more difference averse		Swedish children less difference averse and more social-welfare oriented compared to Austrian children
Fehr et al. (2013)	8–17	717	AUT	DG	Older children more pro-social, less envious, weakly altruistic type, more parochial	Females more egalitarian		
List and Samek (2013)	3–5	122	U.S.	DG		Females more altruistic		
Bauer et al. (2014)	4–12	275	CZE	DG	Older children more pro-social, more altruistic		Low SES less altruistic and more spiteful	
Angerer et al. (2015a)	7–11	1,070	IT	DG	Older children more altruistic	Females give more		
Ben-Ner et al. (2015)	3–6	147	U.S.	DG	Older children give more			Parent and child giving not correlated
Blake et al. (2015)	6–13	433	IT	DG	Older children give more			Social norm on giving increases giving
Deckers et al. (2015)	7–10	732	GER	DG	Older children more altruistic	Females more altruistic	Low SES do not become more altruistic with age	
John and Thomsen (2015)	10–16	895	GER	DG, PGG				Academic track children give more in DG

(*continued on next page*)

Table 4 (*continued*)

Authors	Subject Pool			Experimental Task	Results			
	Age	Sample size	Country		Age	Gender	SES	Other
Cappelen et al. (2016)	7–8	303	U.S.	DG				Majority of children found inequality fair if there was initial inequality
Chen et al. (2016)	6–12	231	IT	DG	Older children give more			Popularity promotes pro-social behavior when decisions are public
Maggian and Villeval (2016)	7–14	637	IT	DG, lying option	Older children less selfish, more efficiency concerned	Young females more egalitarian		
Almås et al. (2017)	14–15	524	NOR	DG, spectator			Low SES more egalitarian	
Angerer et al. (2017)	6–11	824	IT	Spectator		Females discriminate less		
Brocas et al. (2017)	6–18	334	U.S.	DG, PD	Increasing altruism until grade 4 then drops			
Deckers et al. (2017)	7–9	435	GER	DG			Low SES less altruistic	
Kosse et al. (2018)	7–8	607	GER	DG			Low SES less pro-social	Mentoring program increases pro-sociality, altruism, and trust
Sutter et al. (2018)	8–17	883	AUT	DG, spectator	Younger children more inequality averse, older children increasing efficiency concerns	Females primary motive maximin, males primary motive efficiency		

abbreviations: dictator game (DG); prisoner's dilemma (PD)

Kosse et al. (2018) show that maternal pro-sociality and interaction patterns are able to predict pro-social behavior of 7–8-year-olds. The socio-economic status of parents also plays a role. Children from low SES-backgrounds are less altruistic and more spiteful (Angerer et al., 2015a; Bauer et al., 2014; Deckers et al., 2017; 2015; Kosse et al., 2018). For example, only 33% of low SES children prefer the egalitarian option of (1,1) over option (2,0) in the sharing game of Fehr et al. (2008), while almost half of high SES children select that option (Bauer et al., 2014).

Given the importance of SES for social preferences and given the relevance of social preferences as a non-cognitive skill that facilitates cooperation, Kosse et al. (2018) have run an intervention study to check whether social preferences are malleable. From control groups they see that there is a considerable gap in the social preferences of children from low SES-backgrounds and those from high SES-backgrounds. By implementing a mentoring program with a mentor who acts as a benevolent friend and spends time with a child from low SES-families, these treated children score about 25% of a standard deviation higher on the pro-sociality scale than children in the control group with low SES, and the intervention even closes the gap between treated low SES-children and those (untreated) from high SES-backgrounds. Hence, their study provides causal evidence that social preferences can be changed. One of the channels through which this works is that the intervention affects beliefs about pro-social behavior of others. Another intervention has been run by Cappelen et al. (2016) who have studied the effects of early education on social preferences by admitting either children to different preschool programs or by building up a parenting academy. These interventions on 3–4-year-olds lead to significantly higher levels of prosociality at age 7–8, showing that education programs can make children more prosocial. The literature has also examined other factors that determine children's and adolescents' social preferences. One of them refers to in-group favoritism, or in other words to the distinction between in-groups and out-groups. If a recipient belongs to the same social group it is typically associated with more generous behavior of the decision maker towards the recipient (Fehr et al., 2008; 2013). The same social group is usually defined as someone from the decision maker's class in school, from the same school or even only someone speaking the same language – whereas the outgroup is formed by someone from a different class, a different school or someone speaking a different language (Fehr et al., 2008; 2013). Even when children act as spectators and have no stakes in the decision, in-group favoritism is prevalent (Angerer et al., 2017). Especially boys' allocation choices are shaped by strong parochialism. While both genders discriminate against children of a different language group, about one quarter of 6–11-year-old boys decide strongly in favor of their own language group compared to only about one sixth of girls (Angerer et al., 2017).

Further factors that may affect sharing behavior of children and adolescents range from the information about a recipient's neediness or the prevailing social norms in the child's environment to a child's level of self-control. When the recipient is framed as "poor" (e.g., a child with no toys) or the donated money is given to a charitable cause, children become more generous. For example, Bettinger and Slonim (2006) observe higher donations to charities than when children share with their peers (38% versus 26%). Announcing decisions publicly to the classroom – and thus appealing to social image concerns – further increases the level of sharing in school children, especially for popular children (Chen et al., 2016). At the same time, however, a public announcement of decisions can reduce the amount sent in a dictator game if the situation is framed as a competition where the winner is the one who keeps the largest amount for him- or herself (Houser and Schunk, 2009). Furthermore, social norms of sharing play an important role for children and adolescents as making sharing norms salient induces higher rates of giving (Blake et al., 2015; Eckel et al., 2011). The level of self-control and IQ can positively influence the amount sent, while risk and time preferences affect donations positively, but in a non-linear way (Angerer et al., 2015a; Blake et al., 2015; Chen et al., 2016; Eckel et al., 2011; John and Thomsen, 2015).

Summary social preferences in individual decision making tasks. Very young children in kindergarten have mostly selfish tendencies in the dictator game and variants thereof, especially if it is costly to make a recipient better off. When entering school, children become more generous towards recipients, in particular needy ones, and they become in particular inequality averse in later childhood. The predominance of egalitarianism is not sustained for adolescents, however, as they are primarily motivated by efficiency and social welfare concerns. On top of that, adolescents become meritocratic, meaning that they make their allocation decisions dependent on subjects' levels of exerted effort. Girls are typically more generous and more inequality averse than boys who care more about efficiency. Children from low SES-backgrounds are often less pro-social and less generous, and there is a positive relation between parents' and children's social preferences. Other factors like in-group favoritism or self-control also play a role for social preferences. (Table 4)

6. Social preferences II: bargaining games

Social preferences – like a concern for fairness or efficiency – are also important in interactive games where two parties bargain with each other (in a stylized way). The two most often used bargaining games with children and adolescents are the ultimatum game and the trust game. We deal with each of them consecutively.

6.1. Ultimatum game

In an ultimatum game, a proposer is equipped with a fixed endowment and can offer some of it to a responder. The responder can either accept the offer – in which case the proposed allocation is implemented – or reject it – in which case both the proposer and the responder receive nothing. Obviously, fairness concerns of proposers play an important role

in this game, but also strategic considerations due to the responder's power to reject what he or she considers an unfair offer.[6] Considering the development of offers in the ultimatum game contingent on age, the literature does not provide a clear-cut pattern. Harbaugh et al. (2003a) find that offers increase significantly, but modestly, with age in their sample of 7–18-year-olds. They use a one-shot ultimatum game with incentives. When any of these two features is changed, results look differently. Murnighan and Saxon (1998) use a purely hypothetical scenario, and in such a setting younger children made larger offers in the ultimatum game than older children. Harbaugh et al. (2007) repeated an incentivized ultimatum game, and there they find no age effect on offers in their group of 8–18-year-olds. The pattern of behavior is qualitatively similar to adult behavior (Güth and Kocher, 2014). When endowed with ten tokens almost half of children and adolescents propose the egalitarian outcome of five tokens each, while 20% of proposals are lower than three tokens (Harbaugh et al., 2007). Across repetitions, Harbaugh et al. (2007) observe an interesting learning effect that is stronger for younger than for older children. Receiving a rejection prompts especially young children in the role of proposer to increase their offer in the next round, indicating reinforcement learning and strategic behavior. Sutter (2007) also reports no age effects in his study of mini-ultimatum games with 7–15-year-olds. In these mini-ultimatum games, proposers always face only two allocations from which they can choose, and responders can then accept or reject the selected allocation. One of the available allocations is very unfair, as it yields 8 units of money for the proposer, but only 2 units for the responder – noted as allocation (8,2). Varying the alternative allocation – that can be (10,0), (8,2), (5,5) or (2,8) – it is possible to study the importance of intentions. For instance, offering (8,2) when the alternative would be (10,0) is a kind act, while it is not when the alternative is (5,5). It turns out that both proposals and rejection rates are practically the same for children (up to age 10) and adolescents (up to age 15), but that both children and teenagers base their rejection decisions relatively more than adults on actual outcomes (i.e., payoffs) rather than the proposer's intentions. This means that intentionality in a bargaining process is more important for adults than in pre-adulthood.

Rejection rates in the standard ultimatum game increase monotonically when offers get smaller, but they are also not contingent on age, as Harbaugh et al. (2007) show. An insignificant age effect on rejections is also reported in Castelli et al. (2010), although they note a trend that younger children seem to accept unfair offers slightly more often. The focus of their paper is, however, not on age (in their set of 5–10-year-olds), but on the effect of theory-of-mind on ultimatum game behavior. In this respect, they find that children who have developed theory-of-mind are more likely to accept unfair offers.

None of the above mentioned papers report any statistically significant differences in the size of offers or the acceptance rates between boys and girls (Castelli et al., 2010; Harbaugh et al., 2003a; 2007; Sutter, 2007), so gender does not seem to play a major role in ultimatum game behavior.

6.2. Trust game

In a trust game, a trustor has some fixed endowment and can transfer a fraction (from 0% to 100%) to a trustee. The transferred amount is typically tripled, and then the trustee can send back any amount that he or she finds suitable (without any tripling of the return, though). The trustor's decision is usually interpreted as a measure of trust, whereas the trustee's decision is used to measure trustworthiness. Looking at how much children in the role of the trustor transfer to the trustee, it is evident that younger children transfer less than older children. Elementary school children (at roughly age 8–9) pass the smallest amount (Harbaugh et al., 2003b; Sutter and Kocher, 2007). Sutter and Kocher (2007) find a monotonic increase in transfers with increasing age all the way to adulthood, while (Harbaugh et al., 2003b) only observe an increase until the 9th grade (around age 15), but a decrease in transfers for 12th graders. Both papers, nonetheless, confirm children and adolescents to be less trusting than adults.

Relative returns normalize the trustee's return to the trustor by the amount of the tripled transfer. These relative returns are reported to increase with age in (Sutter and Kocher, 2007). 8–12-year-olds have the lowest return rate ranging from 10% to 15%, while for adolescents it increases to roughly 30%. Harbaugh et al. (2003b), however, do not observe an increase in relative returns with increasing age. One potential design difference is that they use a strategy method for trustees by which the latter have to indicate their return for each possible level of the transfer, while Sutter and Kocher (2007) only ask for the return for the actual level of the trustor's transfer (so-called direct method). Both studies, however, note that returns depend positively on transfers, which indicates that reciprocity is a prevalent behavioral pattern already in childhood and adolescence. Both studies also agree in the finding that, given the actual return rates, the payoff maximizing strategy for children and adolescents is to send (close to) zero, while adults maximize expected payoffs by showing full trust and transferring their full endowment (Harbaugh et al., 2003b; Sutter and Kocher, 2007).

Concerning gender effects, both studies find hardly any differences, except for very narrow age brackets. Harbaugh et al. (2003b) observe higher trust levels of 8–9-year-old boys, and Sutter and Kocher (2007) higher trustworthiness of girls aged 8–9. Other than that, gender seems to be uncorrelated with trust game behavior.

Felfe et al. (2018) present an interesting natural field experiment about the effects of birthright citizenship on trust in German 15–16-year-olds. They study the behavior of native and immigrant adolescents, exploiting a law change in Germany in the year 2000 which automatically awards newborns within Germany with German citizenship. The hypothesis is that

[6] The strategic considerations refer back to the ability of children and adolescents to understand strategic games and act sophisticatedly in such games. Section 2 has dealt with this aspect.

Table 5
Social preferences - Bargaining games

Authors	Subject Pool			Experimental Task	Results			
	Age	Sample size	Country		Age	Gender	SES	Other
Murnighan and Saxon (1998)	5–15	240	U.S.	UG	Younger children offer more and accept less	Females give more		
Harbaugh et al. (2003a)	7–18	310	U.S.	UG, DG	Older children give more	Females give more		
Harbaugh et al. (2007)	8–18	256	U.S.	UG	Older children make more consistent proposals			Observing larger proposals by others leads to larger own proposals
Sutter and Kocher (2007)	7–15	200	AUT	UG				Even when proposer has no choice, 46% of children reject unfair offers
Castelli et al. (2010)	5–10	177	IT	UG	Younger children accept unfair offers more often			Theory of mind reduces acceptance of unfair offers
Harbaugh et al. (2002)	8–17	153	U.S.	TG	Increase in trust until ninth grade, steep decrease for twelfth graders	Third grade: females less trusting		
Sutter and Kocher (2007)	8–16	662	AUT	TG	Older children make higher transfers	Eight year-olds: females return more		
Felfe et al. (2018)	15–16	4,077	GER	TG				Immigrant children (especially girls) discriminate against native children

abbreviations: ultimatum game (UG); trust game (TG)

German citizenship for second-generation immigrants should lead to less discrimination between natives and immigrants. In fact, this is what they find, although the effect is significant only for boys. Those born immediately after the law change almost close the gap in the transfers to natives or immigrants, while for boys born immediately before the law change, there is a strong gap of about 20%, thus yielding much lower efficiency levels in interaction. This natural field experiment shows that behavior of adolescents is influenced by legal conditions of citizenship.

Summary social preferences in bargaining games. Fairness and efficiency concerns are important in bargaining games. When running ultimatum games with children and adolescents, they accept equal splits of the pie most often, and rejection rates increase in the spread between the proposer's and responder's share. Age effects are at best weak, since fairness concerns seem deep rooted and early developed. In trust games, transfers of trustors increase with age, which might coincide with the increasing importance of efficiency when children turn into adolescents, as shown in the previous section. There is some evidence that trustworthiness of trustees also increases with age, meaning that the extent of reciprocity might increase with age. In both games, there are hardly any gender effects on behavior (Table 5).

7. Social preferences III: games of cooperation

Cooperation is almost always measured by either running a prisoner's dilemma game or the generalized version of it, a public goods game. These games of cooperation are characterized by a tension between individual incentives to defect (i.e., not cooperate) and a collective interest in cooperation as it maximizes social welfare, i.e., the size of the pie that can be generated in these games.

The majority of studies on cooperation of children and adolescents reveal that older children are more likely to cooperate, while younger children defect more often or contribute less in public goods games with a continuous action space (Angerer et al., 2016; Brocas et al., 2017; Fan, 2000; Harbaugh and Krause, 2000; Houser et al., 2012). A variant of a prisoner's dilemma game is used by Brocas et al. (2017) who let children from age 5 onwards play an alternating allocation task that is equivalent to a sequential, symmetric prisoner's dilemma game in which subjects have to trade off the short term gains from defection (i.e., selfishly picking the more rewarding option) and the long term gains from cooperation (going for the equal payoff for both players). They observe an age trend all the way through childhood and adolescence as cooperation increases with age. A similar pattern is observed in Angerer et al. (2016) who let 6–11-year-olds play a prisoner's dilemma game (where each subject has 5 tokens and each token sent to the other player is doubled in value). The 11-year-olds send about 25% more tokens to their partner than then 6-year-olds, and the increase is fairly linear across age. Some papers do not show a significant age trend, though. Lergetporer et al. (2014) and John and Thomsen (2015) observe on average the same cooperation levels across each age group for 7–11 (10–16)-year-olds. Yet, both papers report a slight – but insignificant – tendency for cooperation rates to increase with age. Cipriani et al. (2013) find no significant age effect as well. However, their sample size (with 38 observations) is by far the smallest in the set of papers considered in this section, for which reason their null result might be taken with care.

Overall, girls and boys do not differ noticeably in their likelihood and extent of cooperation (Brocas et al., 2017; Cárdenas et al., 2014; Fan, 2000; Harbaugh and Krause, 2000; Hermes et al., 2018; John and Thomsen, 2015; Lergetporer et al., 2014). There is, nonetheless, a slight suggestive tendency for girls to cooperate more. For instance, Angerer et al. (2017) observe girls between the ages of 6–11 to be more cooperative than boys. Investigating gender differences in cooperation between Columbia and Sweden, results suggest Columbian girls to cooperate less than Swedish girls and Swedish girls to be more cooperative than Swedish boys. Children also tend to cooperate more with boys than with girls (Cárdenas et al., 2014).

Not much is known about the influence of family background on cooperation levels of children and adolescents. Cipriani et al. (2013) do not find any effect of their controls for socio-demographic background characteristics, but note the small sample size. They also fail to find a relation between parents' behavior and their children's behavior in the public goods game. Yet, family bonds do matter for children's level of cooperation, as Peters et al. (2004) show. They let children and parents play a public goods game. In one condition children are paired with their own parents, whereas in another they are paired with other children's parents. When the game is played only among family members, children contribute substantially more to the public good. Parents, however, do not condition their cooperation on whether or not they are paired with their own children or children of strangers. Hermes et al. (2018) study whether parents (and teachers) are able to predict the level of cooperation of their children through a questionnaire. They find that this is not the case.

Resembling the evidence from allocation tasks discussed previously, cooperation of children and adolescents depends on distinctions between in-groups and out-groups. Angerer et al. (2016) present an example of this effect by exploiting group identity in a bilingual city (where half of the inhabitants speak German and the other Italian and where schools are segregated by language). In their set of 6–11-year-olds, they find that children are least cooperative in a prisoner's dilemma game when matched with a child from the other language group (i.e., the out-group). The level of cooperation is higher when a child is matched with someone from the same language group, but a different school, and highest if the match is with someone from the same class (which implies the same language).

One way to increase cooperation in children may be through educational interventions. Fan (2000) examines whether special lectures that teach the value of cooperation can increase cooperation, but she fails to find an effect. Another intervention can be the introduction of a third, uninvolved party who has the ability to punish uncooperative behavior. This is usually called third party punishment. Lergetporer et al. (2014) find that such a costly punishment option for an uninvolved

Table 6
Social preferences – Cooperation

Authors	Subject Pool			Experimental Task	Results			
	Age	Sample size	Country		Age	Gender	SES	Other
Fan (2000)	6–11	196	TWN	PD	Older children cooperate more			Lecture on cooperation had a short term positive effect on cooperation levels
Harbaugh and Krause (2000)	6–12	208	U.S.	PGG	Older children cooperate more but learn to free-ride			
Peters et al. (2004)	9–16	68	U.S.	PGG, in/out-group				Parents give substantially more than children
Houser et al. (2012)	6–11	406	IT	Common pool resource game	Older children resist more in public condition			
Cipriani et al. (2013)	5–12	38	U.S.	PGG				Parent's contribution does not affect that of child
Cárdenas et al. (2014)	9–12	800	COL & SWE	PD				
Lergetporer et al. (2014)	7–11	1,120	IT	PD, TPP				TPP more than doubled cooperation rates
John and Thomsen (2015)	10–16	895	GER	DG, PGG				Academic track children give more in DG
Angerer et al. (2016)	6–11	828	IT	PD	Older children cooperate more, more parochial	Females cooperate more		Cooperation highest for children in same school-class who speak same language, lowest for other language
Brocas et al. (2017)	6–18	334	U.S.	DG, PD	Older children cooperate more			
Hermes et al. (2018)	6	129	GER	PGG				Children cooperate conditionally

third party increases cooperation rates of 7–11-year-olds considerably by doubling them, in fact. The increase is due to two main reasons. The first, and straightforward factor is that the fear of getting punished lets subjects increase their likelihood of cooperation. Second, and less obvious, is the fact that players in the prisoner's dilemma become more optimistic about their partner's likelihood of cooperation when a third party with a punishment opportunity is present (who may punish the partner as well). Due to more optimistic expectations about the partner's likelihood of cooperation, players become more cooperative themselves – which proves that already young children are conditional cooperators.

Summary cooperation. The level of cooperation is typically increasing with age, in particular in childhood. Younger children free-ride more often than older ones, while adolescents display more prosocial and reciprocal motives in public goods and prisoner's dilemma games. Gender effects are largely absent, and so far there is also little knowledge about the influence of family background. In-group favoritism promotes higher cooperation levels, as does the presence of third parties with an option to punish defectors (Table 6).

8. Competitiveness

Here, we focus on competitiveness in the sense of a willingness to expose oneself to a competitive situation. We are not looking specifically at performance under competition, but rather at a preference to compete at all.[7] Most studies that investigate competitiveness follow the seminal design by Niederle and Vesterlund (2007) where participants perform a specific task in three different stages. In the first stage, they are paid a piece-rate, hence there is no competition. In the second stage, there is a tournament where only the winner gets paid (a higher piece rate than in the first stage). Finally, in the third stage, subjects are free to choose their compensation scheme by either selecting the piece rate or the tournament. It is the choice of the tournament in stage three that measures the willingness to compete.

Looking at the development of competitiveness across age, it seems to be the case that very early on, from age 3–6, children become more likely to compete in several studies (Khachatryan et al., 2015; Khadjavi and Nicklisch, 2018; Sutter and Glätzle-Rützler, 2015; Sutter et al., 2016). For example, Khadjavi and Nicklisch (2018) report in their study with 3–6-year-olds that the likelihood to compete increases by around 10 percentage points with each year. Beyond this early age, the literature does not report a clear-cut pattern in the willingness to compete (Sutter and Glätzle-Rützler, 2015), while with respect to performance in a given task children and adolescents become almost always better the older they get (Andersen et al., 2013; Khadjavi and Nicklisch, 2018; Sutter and Glätzle-Rützler, 2015; Sutter et al., 2016).

Most studies with children and adolescents document a strong gender gap in the willingness to compete (Almås et al., 2016; Andersen et al., 2013; Booth and Nolen, 2012a; Buser et al., 2014; Dreber et al., 2014; Sutter and Glätzle-Rützler, 2015; Sutter et al., 2016). Overall, girls are much less likely to choose a competitive payment scheme than boys. For example, in the study of Buser et al. (2014), 15 year-old girls have a 23 percentage point lower probability of choosing the tournament after controlling for performance and the associated likelihood of winning. In their subsample of 9–18-year-olds, Sutter and Glätzle-Rützler (2015) report a similar magnitude of the difference, since 40% of boys choose to compete in a math task, but only 19% of girls.[8] Again, a similar gap is found in Almås et al. (2016) where more than 50% of boys, aged 14–15, compete, while only 32% of girls choose to enter competition. Interestingly, the gender gap, if anything, is slightly getting larger in a panel study conducted by Sutter and Glätzle-Rützler (2015) who find that over a span of two years girls become even less likely to choose competition during adolescence while for boys there is hardly any change when they get two years older.

The literature is less clear about whether there is a specific age in which the gender differences in the willingness to compete set in – which would be important information for potential policy interventions. In her set of 3–5-year-olds in the U.S., Samek (2013) does not observe any gender differences in competitiveness. Sutter and Glätzle-Rützler (2015) – covering an age range from 3–18-year-olds in Austria – find a gender gap for 5-year-olds and the gap persists beyond that age. Going to less developed societies in Northeast India, Andersen et al. (2013) do not find a gender gap until the age of 12, but from then on the gap persists as well. This means that there might be an interaction between the cultural and economic background of a society and the gender gap in competitiveness. Andersen et al. (2013) study is an example for that. They study matrilineal and patriarchal societies. In societies based on strong patriarchal structures girls exhibit significantly lower competitive preferences compared to girls in matrilineal societies. This effect appears in adolescence and persists from then on. There is also some literature documenting that in less developed countries there may be no gender differences in competitiveness. Khachatryan et al. (2015) find no gender differences in the willingness to compete in 7–16-year-old Armenians. Zhang (2011) investigates 11–15-year-old high school students in rural China and finds no gap between boys and girls when they belong to the majority group of Han Chinese. In ethnic minority groups, however, she observes the typical gender gap of boys being more willing to compete than girls. So, the evidence seems to suggest that in highly developed countries one can typically observe a gender gap in the willingness to compete, while in developing countries this is not the case or the gap emerges later or only for subgroups. Almås et al. (2016) provide a potential explanation for

[7] Gneezy and Rustichini (2004) look at performance of 10–11-year-olds in a running task under competition. They observe that when running alongside another subject, boys improve their performance by a wide margin, while the performance of girls deteriorates. In their case, children had no choice, however, whether they wanted to compete or not.

[8] Most worryingly from an efficiency point of view is the observation that the gender gap is even more pronounced in the top-performing quartile of subjects where Sutter and Glätzle-Rützler (2015) and Sutter et al. (2016) find a gap of almost 40 percentage points between boys and girls.

Table 7
Competitive preferences

Authors	Subject Pool			Experimental Task	Results			
	Age	Sample size	Country		Age	Gender	SES	Other
Gneezy and Rustichini (2004)	9–10	140	ISR	Running task		Males improve performance in second round		Gender composition boy-boy: improved performance by large margin; girl-girl: worse performance
Zhang (2011)	11–15	544	CHN	Math task	Gender gap emerges in high school	Females less competitive only for ethnic minorities		
Bartling et al. (2012)	5–6	223	GER	Flipping toy frogs into pond			Low SES children with recent medical condition less competitive	
Booth and Nolen (2012a)	15	260	U.K.	Maze task		Females less competitive		Females in single-sex schools more competitive
Andersen et al. (2013)	7–15	318	IND	Throwing tennis ball into a bucket	Gender gap emerges at age 13	Females from patriarchal society less competitive		Older females in matrilineal societies more competitive
Samek (2013)	3–5	123	U.S.	Toy fishing task				
Buser et al. (2014)	14–15	362	NL	Math task		Females less competitive		Competitiveness can predict study track
Dreber et al. (2014)	15–19	216	SWE	Math and verbal task		Females less competitive in math task		
Khachtaryan et al. (2015)	7–16	824	ARM	Running, skipping rope, math, verbal task	Older children compete less in math task	No gender gap in tournament entry		
Sutter and Glätzle-Rützler (2015)	3–18	1,570	AUT	Running, sorting, math task		Females less competitive in all tasks		Competitiveness persists over two years
Almås et al. (2016)	14–15	523	NOR	Math task		Females less competitive	Low SES children less likely to choose competition (especially males)	
Sutter et al. (2016)	10–17	588	AUT	Math task	Older males more competitive	Females less competitive		Preferential treatment of females increases competitiveness
Alan and Ertac (2018b)	10	1,900	TUR	Math task		Females less competitive		Grit and role model interventions increase competitiveness
Khadjavi and Nicklisch (2018)	3–6	84	GER	Running task				If parents are highly ambitious even slow children opt for competition

this cross-country pattern. They show in a sample of 14 to 15-year-old Norwegians that there exists a large and significant gender gap in the willingness to compete among adolescents who have parents with high education levels. However, there are no significant gender differences among adolescents with parents who have low levels of education, indicating that it is, perhaps, the level of parental education that matters. Generally speaking, these findings suggest that the overall education level – which presumably influences economic development – may explain why in less developed countries with lower overall education levels like India, Armenia or rural China gender differences in the willingness to compete seem not to exist among adolescents or at least set in at a later age compared to highly developed countries like Sweden, Norway or Austria.

The gender differences in competitiveness seem to be related to two other factors that differ across gender: beliefs about one's own (relative) performance and risk preferences. Boys are typically much more confident (i.e., often overconfident) that they win the tournament, for which reason it is reasonable for them in expectation to choose a competitive payment scheme. Evidence for such gender differences in expected performance abounds (Buser et al., 2014; Dreber et al., 2014; Sutter and Glätzle-Rützler, 2015; Sutter et al., 2016). There is also a gender difference in risk aversion (see also Section 4) that contributes to the gender difference in competitiveness. Since the tournament payment scheme is risky (compared to the safe payment of a piece-rate scheme), more risk averse subjects are less likely to choose a competitive payment scheme. Given that girls are typically more risk averse than boys (Buser et al., 2014; Cárdenas et al., 2012; Dreber et al., 2014; Khachatryan et al., 2015; Sutter and Glätzle-Rützler, 2015), this difference also explains part of the gender gap in the willingness to compete. It is important, however, that controlling for both – beliefs about expected performance and risk aversion – there is usually still a significant gender gap left that is not explained by these two factors, and the unexplained gap is usually in the range of around 10 percentage points (Almås et al., 2016; Buser et al., 2014; Sutter and Glätzle-Rützler, 2015).

As already implied above, a low socio-economic status of a child's family has a negative influence on the likelihood to compete (Almås et al., 2016; Bartling et al., 2012). This effect is particularly strong for boys (Almås et al., 2016). Low SES can also be related to health issues, as Bartling et al. (2012) argue. Children who have had more health issues in recent months and come from a low SES background are about 10 percentage point less willing to self-select into competition. Khadjavi and Nicklisch (2018) reveal another facet of parental influence. Their ambitions for their offspring's achievements can positively increase preschoolers' likelihood to choose a competitive payment scheme (Khadjavi and Nicklisch, 2018). This means that education styles and parental attitudes and wishes for their child seem to affect the competitiveness of children and adolescents.

Experimentally elicited preferences for competition have been shown to predict important field behavior of adolescents. Buser et al. (2014) let 14–15-year-old Dutch secondary school students make experimental choices on their willingness to compete and then relate these choices to their selection of academic tracks. The more math- and science-intensive tracks are not only more prestigious, but they are also lead indicators of tertiary education and labor market success later on in life. Buser et al. (2014) find that the willingness to compete is a good predictor of choosing the more prestigious academic tracks, even when controlling for gender, academic abilities and a host of other relevant background variables.

Given the importance of a willingness to expose oneself to competition, Sutter et al. (2016) have explored whether girls can be encouraged to compete by introducing policy interventions like affirmative action programs. In their experiment, they study the effects of quota rules (where among a set of winners a minimum number must be female) and of preferential treatment (mimicking a rule that is applied in many countries, namely that in case of equal qualifications women need to be given preferential treatment in filling a position), and they find that both measures induce in particular girls with high abilities to choose the competitive payment scheme rather than the piece rate. By and large, both measures close the gender gap in the willingness to compete. Another way of closing it is presented in Alan and Ertac (2018b) who have ran an intervention on grit – by which elementary school students learn the role of effort in achievement and are encouraged to become more persistent in tasks. Treated children do not show any gender gap in the willingness to compete, mainly because it seems to increase girls' optimism about their future performance.

Summary competitiveness. There is a large gender difference in the level of competitiveness, with girls typically shying away from competition much more often than boys do. This effect is in many, particularly highly developed, countries prevalent already in childhood, and persists during adolescence. Parts of this gender gap can be explained by gender differences in (over)confidence and risk preferences. Competitiveness is lower in children from low SES-backgrounds, and girls' willingness to compete can be increased through affirmative action programs. (Table 7)

9. Conclusion

Over the past 15 years, and with accelerating pace, experimental economics has discovered a strong interest in the economic decision making of children and adolescents.The experimental method has created plenty of opportunities to study the development of economic behavior in pre-adulthood. Age, gender, and other factors such as socio-economic background or in-group favoritism have been found to shape economic behavior of children and adolescents, with the latter often showing patterns of behavior that are similar to the evidence from adult subject pools. Acquiring knowledge on the development of behavior and the factors shaping it is a prerequisite for potential policy interventions that aim at promoting one type of behavior more than another. On the basis of the research described in this survey, a new wave of intervention studies

has very recently got off the ground and it will provide many very important insights in the years to come. For instance, the intervention studies by Alan and Ertac (2018a) or Kosse et al. (2018) have shown ways to make young children more patient in their intertemporal choices and more prosocial and fairness-oriented in allocation tasks. This survey may prove useful for future intervention studies as it has intended to provide a diagnostic picture of what we know about the patterns of economic behavior before adulthood.

As such, this survey, as any other, has been selective. We have concentrated on the types of economic behavior that we consider most important and about which there has been most research done to date, namely risk, time, and social preferences, and competitive behavior. For each of these, subdivided into seven sections (including a section on rationality of children's choices), we have attempted to present an overview of the main determinants identified in the main papers on a specific dimension of behavior. The summaries at the end of each section have captured the main findings, in particular the influence of age and gender. Given the summaries in each section, however, we are not going to repeat the main findings here (please refer to the end of each section), but rather devote the conclusion of the paper to a few topics not covered here and to a brief outlook of what might come next.

While we have tried to focus on the topics that we deem most important – and where most of the experimental economics research with children and adolescents has been done – there are a few other fields that have not been covered or where there is hardly any research up to date. There is a small literature on honesty, respectively deception, in children and adolescents (e.g., Bucciol and Piovesan, 2011; Glätzle-Rützler and Lergetporer, 2015; Houser et al., 2016; Maggian and Villeval, 2016). This literature deals with the question how honesty as a social norm develops and what are the driving factors as to why subjects do not exploit informational asymmetries. Since informational asymmetries may trigger inefficiencies on markets, a better understanding of the conditions under which humans act honestly even under incentives for cheating may provide a better understanding of how social norms (here: of honesty) affect market outcomes. A topic that has not received attention in the experimental economics literature about children so far is the study of coordination games (yet, there are psychological papers on these games; see, e.g., Grueneisen et al., 2015a; Grueneisen et al., 2015b). Given the multiplicity of equilibria, these games are interesting to study with children and adolescents in order to see on which equilibria they might be able to coordinate on and which cues might help to coordinate efficiently. Likewise, information cascades might be interesting to study with children and adolescents because that might help us to understand better how fads (among youths) emerge and what is needed to break information cascades. A recent line of work has started to investigate other non-cognitive skills or personality traits and their relationship to economic preferences. For example, Bucciol et al. (2011) have investigated the role of temptation – and the ability to resist it – on productivity. Alan and Ertac (2018b) and Alan et al. (2016) have studied the role of grit for economic behavior and how curricular interventions can foster it. Deckers et al. (2017) draw an even larger picture by asking how socio-economic status of families shapes a child's personality. Understanding all of these relationships better will help us understand how policy interventions might have desired and how they might avoid undesired effects. So far, for instance, little is known about what happens to one type of economic behavior – say with respect to social preferences – when another type of economic behavior – for instance intertemporal choice in time preference experiments – is targeted in a specific intervention. While it is highly welcome to understand how interventions shape economic behavior in one particular domain – like in the intervention on time preferences in Alan and Ertac (2018a) or on social preferences in Kosse et al. (2018) – one important avenue for future research will be to examine also potentially unintended side-effects on other preference types. Of course, as always in science, the community will take step by step: first collect more knowledge about how specific interventions affect specific behavior – and we need certainly more evidence about what works and what does not – and then also consider interaction effects with other behavior or other personality traits. Besides these immediate steps, another challenge for the future will be to examine the long-run consequences of economic preferences and behavior of children and adolescents on lifetime outcomes, such as educational achievements, success on labor markets or a subject's health status. The relation of time preferences to these long-term outcomes is already fairly well understood, but the knowledge about long-run effects is more limited in the other domains discussed here. In sum, there is plenty of promising work ahead for the ever growing community that uses experimental economics as a tool to understand economic behavior of children and adolescents.

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