

Reputation and Sharing Cooperative Behavior in Virtual Settings: A Comparative Study in Three Stages of the Life Cycle

Reputación y Conducta Cooperativa de Compartir en Entornos Virtuales: Un Estudio Comparativo en Tres Etapas del Ciclo Vital

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Cooperative behavior expressed in the conduct of sharing shows relevant results in the participation of individuals in their social and cultural settings. To account for its efficiency, empiric investigation has shown interest in variables modifying it, as well as changes happening during its development. The present study focuses on information about the reputation of a possible collaborative associate as a modulator and the comparison of its incidence during childhood, puberty, and adolescence. Due to its relevance in socialization of new generations, an interactive virtual setting was presented to participants (metaphor for a videogame) where they would earn resources and could decide to share them with other characters considering information on their reputation. It was found that during childhood, in comparison to puberty, participants share their resources more and consider positive reputation more. Analysis by gender shows that female participants are more sensitive to information on positive and negative reputation at the time of sharing, and that, at the stages of life cycle investigated, behavioral tendency was the informative key to account for reputation.

Keywords: cooperative behavior, sharing, reputation, virtual settings, development

El comportamiento cooperativo expresado en la conducta de compartir resulta relevante para la participación de los individuos en sus entornos sociales y culturales. Para dar cuenta de su funcionamiento, la investigación empírica se ha interesado en las variables que lo modifican y los cambios que ocurren en el transcurso del desarrollo. El presente estudio se centra en la información sobre la reputación de un posible socio colaborativo como un modulator y la comparación de su incidencia en la niñez, la pubertad y la adolescencia. Debido a su relevancia en la socialización de las nuevas generaciones, se presentó a los participantes un entorno virtual de interacción (metáfora de un videojuego) donde ganaban recursos y podían decidir compartirlos con otros personajes teniendo en cuenta la información de su reputación. Se encontró que, en la niñez a diferencia de la pubertad, los participantes comparten más sus recursos y tienen más en cuenta la reputación positiva. El análisis por género muestra que las participantes femeninas son más sensibles a la información de reputación positiva y negativa en el momento de compartir y que, en los momentos del ciclo vital investigados, la tendencia comportamental es la clave informativa para dar cuenta de la reputación.

Palabras clave: Comportamiento cooperativo, compartir, reputación, entornos virtuales, desarrollo

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All living organisms known to us have had to respond to multiple environment-characteristic pressures throughout their evolutionary history (*i.e.* pressures characteristic of the ecological niche to which they belong), from which a series of adaptations have emerged allowing them to survive and hold over generations. In social species (*e.g.* certain types of birds and insects, some fish and the majority of mammals, especially primates) a somewhat organized relationship system among its members has emerged, where they carry out certain duties and constantly communicate amongst themselves, favoring the survival of the whole group.

Social species face not only ecological niche pressures but also demands established within each group and those arising between different groups. In particular, human species have inherited biological and social devices, through which to respond to such environmental and group demands (Tomasello, 2007). Thus, each individual—belonging to a specific group and species in general—receives both an organic and a cultural inheritance, providing them with a series of skills, knowledge, practices and tools. This heritage, useful to other members of the species in the past, allows present individuals to respond to new demands in their own environment and execute an active role regarding the inherited information.

Part of this heritage comes from accumulated information in culture, which is defined by Tomasello (2010) as social learning so complex that different populations in the same species develop different ways of doing things. This ability to respond differently to the same needs depends, partly, on the biological capabilities of each species and that have been developing throughout evolutionary history, which is why it is not possible to bluntly separate culture from biology. However, and in spite of the whole species continuing to share some common basis—phylogenetic—, each population of the aforementioned species generates and expresses a variety of artifacts and cultural practices dependent on the needs arising from the conditions of the environment in which a group of individuals are established. This way, thanks to the culture, a species is provided with behavioral variations depending on the ecological and social niche in which their groups establish.

Tomasello (2010) states that, while it is not a practice exclusive to, the human specie presents a culture quantitatively as well as qualitatively unique, in comparison with social practices in other animals. At the quantitative level, human cultural practices are infinitely ample, and they are present in social groups located throughout the planet; at the qualitative level, there are two central characteristics in those cultural practices (Tomasello, 2007): (1) there is a “cultural ratchet”, meaning, a generation and accumulation of knowledge where individuals from a species take practices and behaviors from their ancestors and adapt them to new needs in the environment; and (2) the establishment of social institutions, in charge of regulating the behavior of groups of individuals, through the implementation of rules and norms that each individual recognizes and enforces on their peers.

Having a singular culture entails a set of singular social abilities present in the members of a species and that, at the same time, also enables the preservation of cultural learning (Tomasello, 2010). Many of these abilities emerge from what the group of researchers from the Max Plank Institute for Evolutionary Anthropology, led by Tomasello, has called Cultural Intelligence, made up by the following skills: (1) to cooperate, (2) to communicate with each other and (3) related to social learning. The skills composing this cultural intelligence depend on certain biological predispositions, as much as the particular way in which each population meets the needs of their ecological niche; meaning these skills emerge in a co-evolutionary process (Herrmann et al., 2007).

Cooperation and its associated factors in humans and other species have been considered fundamental by multiple authors, such as Tomasello (2010), De Waal (2007), Engelmann and Fischbacher (2009) Kappler and Van Schaik (2006), Trivers (1971), among others. Generally, we understand cooperation as a group of interactions among individuals (not necessarily from the same species, but typically so) where acts seeking one or both parties' benefit take place (Tomasello, 2010).

According to Tomasello (2010), cooperation could be divided, basically, into two groups: (1) altruism, understood as self-sacrifice to benefit others and (2) collaboration, the coordination of conduct with other individuals seeking to reach mutual benefit. At the same time, altruism could be divided into three types of differentiated conducts: *helping* which refers to offering actions directed to solving the problems of others, *informing* which could be understood as providing data that could be useful to someone else, and *sharing* as in the act of giving resources to others. Several authors (Olson & Spelke, 2008; Warneken & Tomasello, 2013)

suggest the use of the sharing behavior in studies on cooperation, due to its simple measurement and because it explicitly presents the variable of cost; hence it being the one chosen for the present study.

Research on cooperation in ontogenetic development has found that children have a tendency to cooperate expressed at very early ages (Liszkowski et al., 2004; Olson, & Spelke, 2008; Warneken et al., 2007; Warneken & Tomasello, 2012, 2013; Woodward, 2005). Moreover, as development progresses, a series of social factors are incorporated in this primal tendency, influencing, shaping and directing conduct of cooperation in the individual.

In short, it has been found that development of cooperation has a *negative logic*, as cooperation occurs in a less indiscriminate manner each time (Tomasello, 2010). In this respect, it is socialization that allows conduct to shape accordingly to the subject's previous experience and the social characteristic norms of the culture they are immersed in. Socialization, then, generates selective cooperative conduct according to the contingencies of each situation; that is, keeping in mind the context, "(...) [children] learn to become more selective: they decide who to help, who to give information to and who to share things with" (Tomasello 2010, p. 66).

Judgements and assessments of cooperative situations and the context in which they are immersed in, apparently, have an impact on the motivation of an individual to cooperate with others. Part of these judgments are originated in the individuals' aspects with whom cooperation is possible; one of these aspects is reputation, understood as the beliefs and ideas about others, based on specific traits that are generalized and turned into value judgements (Barclay, 2015). Reputation relates to the selective tendency to cooperate in two different ways: on the one hand, the reputation of others could be used as information to keep in mind when deciding whether to become involved or not in a cooperative situation (Vaish et al., 2010); on the other hand, the construction of the person's reputation is important in order to have an impact on the judgement of others and obtain future benefits (Engelmann & Fischbacher, 2009); both ways follow a cost-benefit system.

When there is a way of identifying an individual with a good or a bad reputation, the advantage of using that information before initiating a cooperative situation lies in the probabilities of obtaining a benefit in return and prevent loss (*i.e.* a non-retributed cost) (Barclay, 2015). Thus, the person learns to interact, to a greater extent, with the type of individuals that they consider having a "good" reputation; and to avoid any interaction with those they consider being deceitful, or having a "bad" reputation. This principle has also been seen in other primates (Herrnman et al., 2013; Subial et al., 2008).

In addition to observing others, people usually invest in their own reputation to be considered as collaborating partners. During childhood, this concern for one's own reputation seems to express in a differential manner. Warneken and Tomasello (2012) found that paternal presence had no effect on helping behavior in small children: twenty-four-month-old children helped at equal rates regardless of whether or not they were being observed by their parents, displaying no concern for their own reputation. Likewise, a study conducted by Hepach et al. (2016) showed that the presence or absence of an adult cooperator did not increase children's likelihood of helping. Finally, Fu et al. (2015) provided three-year-old children information about a third party positive prosocial reputation and then moved over to a situation where they could share or cheat, finding that reputation manipulation had no effect. Therefore, evidence suggests that before the age of 5 one's own reputation is not taken into consideration by children in their cooperative conduct (Engelmann & Rapp, 2018).

After the age of 5, children display more concern for their own reputation (Engelmann et al., 2013). Young children care more about their reputation with ingroup members and potential reciprocators). When children are observed by their own-age-peers, they are less likely to steal stickers from a second agent absent during the situation (Engelmann et al., 2012). Even the belief of being in the presence of an invisible guard decreases the rates of deceit (Piazza et al., 2011). These findings could be interpreted at first as a way to avoid punishment rather than concern over their reputation. However, other studies show that children are more cooperative when their actions are being observed by others, supporting the argument that small children's behavioral change in public situations is better interpreted in terms of a desire to improve their reputation (Buhrmester et al., 1992; Leimgruber et al., 2012).

Children around the age of 8 start explicitly referring to concerns about their reputation by analyzing their behavior in front of an audience (Banerjee et al., 2012). Moreover, children this age seem to adapt their reputation strategy with flexibility, ranging from self-promotion to modesty or responsibility discharge, for the sake of displaying an improved version of themselves (Watling & Banerjee, 2012). In relation to this,

children this age show early signs of skepticism towards positive self-descriptions from others and a growing understanding of the reputation strategies of others (Heyman et al., 2007).

In contrast with studies from which an evolutionary development could be abstracted from the concern of one's own reputation, and taking into account the information on another individual's reputation, no studies shedding light on evolutionary changes in cooperative behavior have been found. Thus, the purpose of the present study is to establish any changes in conduct in three different stages of the life cycle. In this manner, it will contribute evidence to the development of cooperation thesis from a negative logic.

Nonetheless, previously reviewed studies justify the interest variables in real, social interaction settings. However, the current world offers different interaction settings: the so-called virtual settings. Within the latter, videogames have been at the center of controversy on their appearance, due to their commercial success and their high levels of use, particularly in children and adolescents. In Colombia, for instance, the cultural consumption survey conducted by the National Department of Statistics (DANE, 2017), shows that 52.3 % of children between the ages of 5 and 11 actively include videogames as an alternative for entertainment and 42.5 % of people between the ages of 12 and 25 use them frequently. Findings in this field have shown that videogames are a source of pleasure and abundant motivation for players (Choi & Kim, 2004; Hamari & Keronen, 2017), and promote cooperation between people with no previous contact (Cole & Griffiths, 2007; Yee, 2006). Cooperation in videogames could be related to social experience reports of taste and entertainment during the game, the establishment of common objectives and knowledge exchange (Przybylski et al., 2010; Velez & Ewoldsen, 2013; Zhong, 2011).

Studies with adults have shown that, in virtual settings, reputation influences cooperative behavior. Zhang et al. (2014) modeled cooperative behavior introducing information on the popularity of a space videogame player, finding that selection based on popularity promotes cooperation sustainability, regardless of underlying web interaction. Morschheuser et al. (2017) found that cooperation in videogames benefits from normative context, social identity, reputation-mediated joint commitment, attitude towards cooperation, and anticipated positive emotions. Deng et al. (2018) found that cooperation is enhanced when games involve interdependency and there is information on reputation. Yang and Yang (2019) found that in videogames requiring cooperation to obtain common goods, the reputation of the organizer of the group had a remarkable influence.

While these studies were found for adults, data analyzing cooperation-reputation dynamics in virtual settings for children and adolescents were not found. The present study compares cooperative behavior depending on reputation during the three stages of the life cycle (children, preteens, and adolescents), using the metaphor of a videogame to account for changes in these contexts of innovative interaction for the species.

Methods

Participants

The sample consisted 72 participants from the city of Medellin. The totality of the sample was divided into three experimental groups: 24 between the ages of 7 and 8 which will be referred to, henceforth, as the group of children; 24 between the ages of 11 and 13 which will be referred to, henceforth, as the group of preteens; and 24 between the ages of 14 and 16 which will be referred to, henceforth, as the group of adolescents (see Table 1).

For the participation in the study and observing the 2006 ethical considerations of law 1090 containing the deontological and bioethical code for the practice of psychology in Colombia, authorization was requested from the legal guardians of all participants via informed consent and from the participants via informed assent (Congreso Colombiano de psicología, 2006).

Table 1.*Distribution of participants in both experimental groups by gender and age (in months).*

Group		Percentage	Average age in months	Typical deviation age in months
Children	Female	41,7	98,60	2,221
	Male	58,3	96,29	2,946
Preteens	Female	45,8	143,91	5,243
	Male	54,2	146,46	6,603
Adolescents	Female	47,5	178,44	5,503
	Male	52,5	181,93	4,166

Procedure

The phases of the experiment conducted with the participants are described below. The presentation was the same for all three age groups, the difference being that in the application children were given direct support to help them read the instructions, while preteens and adolescents carried out the activity independently in a computer room, though a researcher was always present to address any concerns that may arise. The experiment was designed with PsychoPy, an open-code application that allows the execution of a wide range of neuroscience, psychology and psychophysics experiments.

Phase 1. Familiarization

This is a very important moment as it allows participants to establish an atmosphere of trust. In this phase researchers introduce themselves and ask the participants if they want to play a game they have prepared for them. The designed protocol included the following text: “today we would like to show you a videogame we have designed. Would you like to play with us?” At this moment participants could decide if they wanted to continue or not with the activity.

Phase 2. Game rules

In this phase participants were presented with the following text: “Before we start, it is important that you know a few game rules. First, you must not talk amongst yourselves, the game must be individual, this is why each one of you has the game in the computer. Second, you must read the game instructions on the screen, remember to pay close attention to all the information presented throughout the game. And third, you may raise your hand should you require help with anything, not understand the instructions or have any questions, we will come to you. Once you finish the game please raise your hand, we will come to each one of you so as to not distract your fellow participants who may have not finished yet. Do you have any questions before beginning?” at this time questions and concerns were addressed.

Phase 3. Training and receiving resources for the game

In this phase, participants were asked to choose an avatar that would represent them. Avatars were aliens named “Moteli” or “Sibziane”. The shapes and names of the avatars were not familiar, in an effort to control the strange variable of character identification. After choosing the avatar, the following text appeared on the screen: “the objective of the game is to gather as many tokens as possible. In order to do this you must complete the challenge presented at each level. You will have a limited time to do a challenge, answer as fast as you can!”.

Challenges consisted in simple activities that participants could solve quickly to obtain a token as a reward for the goal achieved. For this, blue or red characters appeared on the screen and the participant must press “S” if the red character appeared and “L” if the blue character appeared. It was made this way as records show that in sharing cooperative conduct, there is relevance in whether shared resources are a product of the effort to obtain them, which is why it was sought that participants earned tokens instead of just getting them. When a participant obtained 17 tokens exactly, the end of this phase was reached.

Phase 4. Use of tokens and reputation information of other characters

After obtaining the 17 tokens, the following text appeared: “you have 17 tokens. To move on to the next level you must spend 5 tokens:”, it was made this way for the participants to realize they would need tokens later on and also to take that into account when sharing. Following this the next text would appear: “you have 12 tokens left. Click on continue to move on to the next level”. At the next level they were given the following instructions:

“Wait! Before continuing, we would like to tell you that there are other players accumulating tokens at this moment, some of them have played longer than you and have reached different achievements. Several players have not been able to earn enough tokens to go from one level to another, which is why they are allowed to ask others for tokens they might have to spare”.

“Look, they are Dumuzi and Resdel, and they need tokens to continue playing. If you want, you could give them tokens.”

Then, more information would appear on the screen about the other players that were also alien-type figures with unfamiliar faces, to control any variable that could lead to identification. The information relating to the character with a positive reputation stated:

“This is Dumuzi, he has achieved ten medals and has reached level 5. Other players describe Dumuzi as an honest player who strives to play well and is a friendly player.”

The information referring to the character with a negative reputation stated:

“This is Resdel, he has achieved one medal and has reached level 2. Other players describe Resdel as a dishonest player who does not strive to play well and is not a friendly player.”

Reputation information was presented according to the operationalization proposed by Barclay (2015), in terms of information on skill (number of medals achieved), availability of the character (level reached) and tendency (personality traits such as honesty and effort).

Phase 5. Act of sharing

After presenting reputation information, a screenshot read “Would you like to give tokens to the other players?”, as well as an image with a parallel, summarized recipients’ reputation information, how many tokens the player has and instructions to share tokens or continue the game. At this moment, the participant decides out of the 12 tokens how many they will keep for themselves and how many they will give to other characters.

Once participants shared their tokens, they were asked the reasons they did this. They wrote down their answers and, subsequently, those were categorized and will be presented in the results.

Results

Presentation of the results are divided into three sections. In the first place, the analysis of participants’ shared and kept tokens is presented with no gender distinction, then a differential analysis by gender is made, and finally an analysis of the categories constructed with the reasons given for token distribution.

Shared and kept tokens by no-gender-distinction participants

ANOVA testing revealed differences in the tokens participants kept for themselves (Sum of squares = 70,778; $gl = 2$; Mean-square = 35,39; $F = 5,175$; $p = ,008$), in the tokens they shared with the character with a positive reputation (Sum of squares = 35,083; $gl = 2$; Mean-square = 17,542; $F = 3,335$; $p = ,041$), but not in the tokens they shared with the character with a negative reputation (Sum of squares = 6,361; $gl = 2$; Mean-square = 3,181; $F = 1,877$; $p = ,161$). Mean values are presented in Table 2.

In multiple correlations among different age groups (Bonferroni correction), differences were identified between the group of children and the group of preteens ($p = 006$) in relation to tokens kept for themselves, but not the adolescents ($p = ,194$). The same happened to tokens shared with the character with a positive reputation, differences are found between the group of children and preteens ($p = 0,032$), but not with the group of adolescents ($p = 512$). These results indicate that children tend to leave less tokens for themselves and share more if the character has a positive reputation, while preteens tend to leave more tokens for themselves and share less with the character with a positive reputation.

Table 2
Shared and kept tokens by participants

		Mean	DT	95 % confidence interval for the mean	
				Lower limit	Upper limit
Tokens kept for themselves	Group 1 (Age 7-8 children)	7,58	2,518	6,52	8,65
	Group 2 (Age 11- 13 preteens)	10,00	2,485	8,95	11,05
	Group 3 (Age 14- 15 adolescents)	9,00	2,828	7,81	10,19
	Total	8,86	2,764	8,21	9,51
Tokens shared with character with a positive reputation	Group 1 (Age 7-8 children)	3,21	2,043	2,35	4,07
	Group 2 (Age 11- 13 preteens)	1,50	2,414	0,48	2,52
	Group 3 (Age 14- 15 adolescents)	2,29	2,404	1,28	3,31
	Total	2,33	2,368	1,78	2,89
Tokens shared with character with a negative reputation	Group 1 (Age 7-8 children)	1,21	1,532	0,56	1,86
	Group 2 (Age 11- 13 preteens)	0,50	1,103	0,03	0,97
	Group 3 (Age 14- 15 adolescents)	0,71	1,233	0,19	1,23
	Total	0,81	1,318	0,50	1,12

Shared and kept tokens by gender-distinction participants

ANOVA testing revealed differences in the tokens female children kept for themselves (Sum of squares = 87,469; $gl = 2$; Mean-square = 43,734; $F = 14,395$; $p = ,000$), in the tokens they shared with the character with a positive reputation (Sum of squares = 46,717; $gl = 2$; Mean-square = 23,359; $F = 13,877$; $p = ,000$), and in the tokens they shared with the character with a negative reputation (Sum of squares = 9,539; $gl = 2$; Mean-square = 4,770; $F = 5,125$; $p = ,013$). Descriptive dates are presented in Table 3.

In multiple correlations among different age groups (Bonferroni correction), differences were identified in relation to tokens kept for themselves by girls in regards to preteens ($p = ,000$), but not between preteens and adolescents ($p = 1,000$) regarding tokens left for themselves. As far as tokens shared with the characters with a positive reputation, differences were found between girls and preteens ($p = ,000$) and adolescents ($p = ,009$), but not between preteens and adolescents ($p = ,284$). Lastly, differences were found between girls and adolescents ($p = ,012$), but not between girls and preteens ($p = ,158$), and preteens and adolescents ($p = ,658$), regarding tokens shared with the character with a negative reputation. Results indicate, then, that girls tend to leave fewer tokens for themselves. They also have a higher tendency to share with the character with a positive reputation than preteens and, lastly, adolescents share less with the character with a negative reputation. In fact, data show 0 tokens shared.

Table 3
Shared and kept tokens by female participants

Females		Mean	DT	95% confidence interval for the mean	
				Lower limit	Upper limit
Tokens kept for themselves	Group 1 (Age 7-8 girls)	7,10	2,378	5,40	8,80
	Group 2 (Age 11- 13 female preteens)	10,91	1,136	10,15	11,67
	Group 3 (Age 14- 15 female adolescents)	10,44	1,509	9,28	11,60
	Total	9,50	2,418	8,60	10,40
Tokens shared with character with a positive reputation	Group 1 (Age 7-8 girls)	3,50	1,434	2,47	4,53
	Group 2 (Age 11- 13 female preteens)	0,55	0,934	-0,08	1,17
	Group 3 (Age 14- 15 female adolescents)	1,56	1,509	0,40	2,72
	Total	1,83	1,783	1,17	2,50
Tokens shared with character with a negative reputation	Group 1 (Age 7-8 girls)	1,40	1,506	0,32	2,48
	Group 2 (Age 11- 13 female preteens)	0,55	0,688	0,08	1,01
	Group 3 (Age 14- 15 female adolescents)	0,00	0,000	0,00	0,00
	Total	0,67	1,093	0,26	1,07

For the male gender, ANOVA testing revealed no differences in tokens boys kept for themselves (Sum of squares = 13,149; $gl = 2$; Mean-square = 6,575; $F = ,756$; $p = ,476$), the tokens shared with the character with a positive reputation (Sum of squares = 3,274; $gl = 2$; Mean-square = 1,637; $F = ,220$; $p = ,803$), nor the tokens shared with the character with a negative reputation (Sum of squares = 3,726; $gl = 2$; Mean-square = 1,863; $F = ,886$; $p = ,428$). Descriptive data are shown in Table 4.

Table 4
Shared and kept tokens by male participants

Males		Mean	DT	95 % confidence interval for the mean	
				Lower limit	Upper limit
Tokens kept for themselves	Group 1 (Age 7-8 boys)	7,93	2,645	6,40	9,46
	Group 2 (Age 11- 13 male preteens)	9,23	3,059	7,38	11,08
	Group 3 (Age 14- 15 male adolescents)	8,13	3,114	6,41	9,86
	Total	8,40	2,931	7,49	9,32
Tokens shared with character with a positive reputation	Group 1 (Age 7-8 boys)	3,00	2,418	1,60	4,40
	Group 2 (Age 11- 13 male preteens)	2,31	2,983	0,51	4,11
	Group 3 (Age 14- 15 male adolescents)	2,73	2,764	1,20	4,26
	Total	2,69	2,673	1,86	3,52
Tokens shared with character with a negative reputation	Group 1 (Age 7-8 boys)	1,07	1,592	0,15	1,99
	Group 2 (Age 11- 13 male preteens)	0,46	1,391	-0,38	1,30
	Group 3 (Age 14- 15 male adolescents)	1,13	1,407	0,35	1,91
	Total	0,90	1,462	0,45	1,36

In multiple correlations between different age groups (Bonferroni correction), no differences were found among them. Results show that for males no significant differences regarding the tokens kept for themselves, nor those shared with characters with a positive or negative reputation.

Rank Analysis

When participants were asked about the reasons leading them to share the amount of tokens they chose to share with Dumuzi (positive reputation) and Resdel (negative reputation), different answers were given, which were categorized by:

Tendency: When the reason to share or not is a result of a general observation on the behavior of the player, for instance: “Because they are the best player”, “I did not share because they are dishonest.”

Skill: When the reason to share or not is a result of game performance, for instance: “Because I thought they are a good player” or “Because they do not know how to play.”

Own resources: The analysis to share or not was based on the amount of tokens the participant had, for instance: “I did not want to spend my tokens” or “Because I had a few medals and wanted to keep all twelve tokens.”

The player’s resources: The analysis to share or not was based on the amount of tokens Resdel or Dumuzi had, for instance: “Because (Resdel) had many” “Because (Dumuzi) had very few.”

Education: The reason to share or not was to teach the character a lesson, for example: “To help them become a better player.”

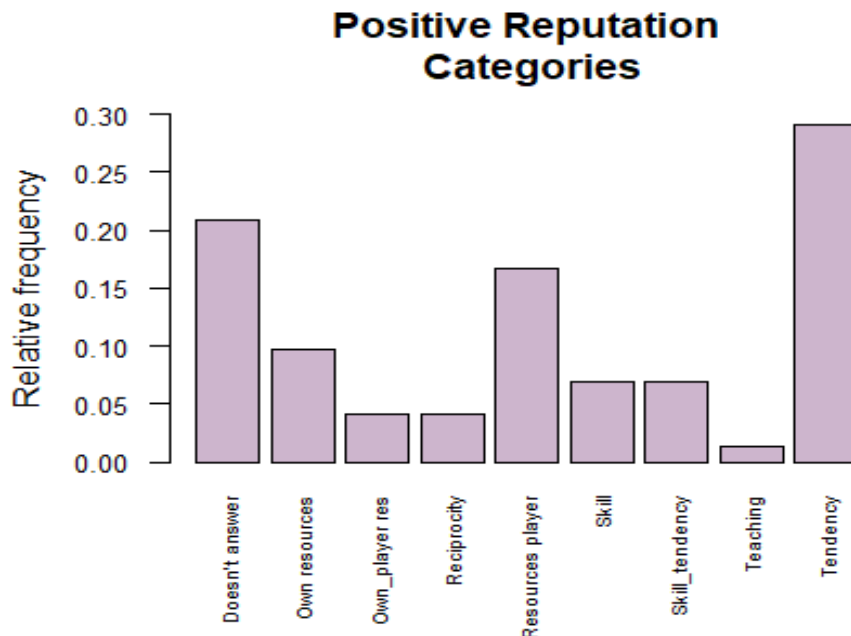
Reciprocity: The reason to share is the anticipation of a posterior interaction “Because he would give me a token if I ever needed one.”

Some of the answers are combinations of these categories. For example, an answer like: “Because they are dishonest and a bad player” was classified as *tendency and skill* and when the participant did not respond or claimed not knowing, it was categorized as *does not know* or *does not answer*.

Taking into account the total of participants, the reasons leading them to share with the participant with a positive reputation were mostly *tendency*, followed by *evaluation of own resources* (see graph 1).

Graph 1

Categories of reasons leading to share with the character with a positive reputation (displayed in percentages)

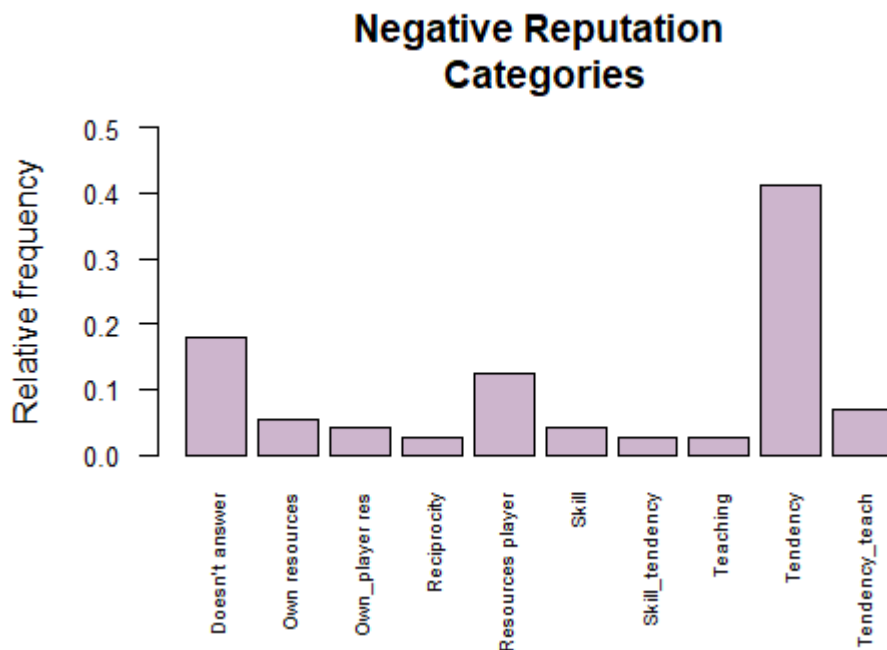


Regarding the character with a positive reputation, *tendency* was also the main reason taken into account when sharing, even at a higher percentage than the one with the positive reputation (see graph 2).

Pearson's Chi-Squared Test was used to see if there was any association between the group where the participant was in and the answer on the leading reasons to share a certain amount of tokens. No association was found for a positive ($p = ,439$) nor a negative reputation ($p = ,185$). The same test was used to establish any association between gender and the same type of questing, finding, once again, no association for a positive ($p = ,641$) nor a negative reputation ($p = ,459$). This indicates that *tendency* was the main variable for participants to take into account when sharing, regardless of their gender and membership group.

Graph 2

Categories of reasons leading to share with the character with a negative reputation (displayed in percentages)



Discussion

Committing in a cooperative situation presents a daily challenge to all participants in a cultural setting. Direct access to information about the reciprocity of a possible partner can bring about many costs and the possibility of deceit is always present. In these circumstances, reputation could be used as decision-making information; hence, it could be used to predict a greater retributive benefit from a partner in future interactions. Therefore, the adaptative issues it could solve are: election of cooperative partners trying to detect cheaters; decrease the uncertainty on whether there will be any future interactions with the potential partner; and finally, encourage a better performance from partners by rewarding high investment in collaborative tasks and punish desertion or low investment (Krasnow et al., 2012).

Given the relevance of influence and reputation in cooperative behavior, it is necessary to give account of the dynamics of such influence in evolutionary development. Findings in the present research allow the following analysis and discussion axis proposal: a negative logic in the development of the use of information on reputation to share resources, an obvious difference of gender in the use of reputation information, a similar behavior in real and virtual interaction settings, and the influence of tendency as relevant information for minors to identify reputation. Next, a discussion of each axis will be presented.

Negative logic in the development over the use of reputation information to share resources

In this study, children—compared to preteens—left less tokens for themselves and shared more with the character of a good reputation. This finding could be interpreted in two complimentary ways: the first by Tomasello (2010), where children tend to innately cooperate in a more indiscriminate way. Although children in the present study are older than those analyzed by the author (younger than 3 years old), what must be taken into account is the comparative matter; there may not necessarily be in them a tendency to share indiscriminately. The fact that they mostly do it with the character with a positive reputation contradicts his affirmation, but though they already use information of others in order to share, they tend to be less egocentric with their resources compared to those who are already at puberty.

The second way that could function as an explanatory factor of this phenomenon goes back to Woodward (2005), who states that the central components of mature knowledge systems are innately specified in the form of abstract principles, but that the action in a social setting provides developmental basis for more specific conceptions referred to concrete situations. In this way, a more abstract cooperation principle under the form of sharing (although positive reputation already has an effect) could be the result of the children's behavior, while preteens behave in a more specific way. How do we understand that?

Findings on participants at puberty leaving more tokens for themselves and sharing less with others regardless of reputation information, results quite striking. Unfortunately, in the academic world in general, puberty is a moment in the life cycle that has received little attention, limited to a set of physiological changes and very few explorations related to mental development. There are only a few studies showing that a late puberty could involve certain posterior difficulties during adolescence, in terms of cognitive skills and school performance (Koerselman & Pekkarinen, 2018; Dubas et al., 1991).

Upon this problem in this contemporary research, maybe a classic such as Vygotsky could shed light over this finding. Although the author would not talk about puberty, in his development theorization thought he did not agree with the characterization of changes, in what he would call age of transition, in terms of changes in emotions and motivation. Vygotsky characterized the age of transition (i.e. puberty) as the age in which the individual developed the ability to think with the help of concepts in contrast with childhood, when the child use pseudo-concepts or complexes. This opportunity to think in concepts revolutionized the knowledge of physical world, the social world and also self-knowledge.

“The function of concept formation, in the age of transition plays a decisive role as it allows the adolescent to enter in their own internal reality, in the world of their own experiences. Words are not only a means of understanding others, but oneself also. Words have meaning for the speaker as, from the beginning, the means of understanding, of perceiving own experiences. For this reason, with just the formation of concepts one can reach the intense development of self-perception, self-observation, deep knowledge of the internal reality, of the world of own experiences. According to the accurate observation by W. Humboldt, thought becomes clear only in concept and it is the understanding of its internal world. Without it, thought could not be lucid, could not become concept” (Vygotsky, 1984, p. 18).

In this order of ideas, it is possible to hypothesize that the seemingly egoistical behavior of preteens in this research, could not necessarily be due to a motivational or emotional aspect in particular, but rather to the possible transit towards a more defined conception of the self, including own resources and the possibility of sharing them, an aspect presenting in a more flexible form in adolescents, who left no more tokens for themselves, nor were they sensitive to positive information, as children were.

In any event, a negative logic in sharing cooperative behavior is evident in the present study, moving from a more generalized practice to a more specific one in the course of its development.

Gender differences in the use of reputation information

When the result analysis of the present study was divided by gender, substantial differences were found. Reputation information had no effect on male participants at the time of sharing their resources. It was the female participants who clearly showed the effect of presentation of reputation information: girls in respect to preteens and adolescents, kept fewer tokens for themselves, which did not happen amongst preteens and adolescents. Girls were also those who shared the most tokens with the character of a positive reputation, while adolescents shared significantly less with the character of a negative reputation.

Gender and reputation studies have had adult women as main subjects and, although these results should not be directly extrapolated to the participants in this study, as it may lose development perspective,

it would offer some clues to analyze the results. According to Reynolds et al. (2018), women seem to utilize reputation information as a form of intrasexual competition in situations of mating. For this purpose, they usually give strategic information to damage the reputation of their competitors (Beersma & Van Kleef, 2012). Meanwhile men also make use of strategic reputation information, not to damage their competitors, but to benefit themselves (Archer, 2004). Women also use reputation information to determine attractiveness, value maternity, intelligence and the status of their congeners, modifying, this way, their behavior around their competition (Rucas et al., 2006).

If studies suggest an evolutionary development of competition between women (Benenson, 2013), we will retake some differences for this discussion. Competition between girls between the ages of 5 and 12 is not usually over boys, whom they segregate and distance from their social relations, but over having other female friends with who they can establish exclusive relationships (Markovits et al., 2001), therefore, competition accentuates at the time of choosing or being chosen as friends (Benenson & Heath, 2006). It is also accentuated when they are witnesses of superior performances by other girls, whom they tend to despise (Goodwin, 1990).

For their part, competition between adolescents seem to be directed towards obtaining attention and favors from men (Burbank, 1987). Adolescents of a high status elicit more respect than others being more spatially connected with the male community than before. This way, adolescents of an inferior status that form alliances with adolescents of a high status could increase access to valuable mates. In practice, rewards rarely come out of this, as a high status adolescent could benefit very little by affiliating with another high status adolescent (Merten, 1997; Eder, 1985).

Reputation could be one of the elements that participate in these dynamics of female competition. What the results of the present study suggest is that female participants are more sensitive to reputation information: young girls will share resources if the reputation is positive and adolescents will not share resources if the reputation is negative. These differences could not be attributed only to different cognitive styles between genders, but differences on social settings of males and females should also be thought about, in terms of a more overt or more covert competition. Because competition is more covert in the female world, being sensitive to reputation information could result adaptative, as much as to damage other female competitors as to look after their own reputation when threatened.

Similar behavior in real and virtual interaction settings

The present research used the metaphor of a videogame to set a cooperative scene and reputation information in a virtual setting. Results agree with what was found in literature about interactions in real settings: a negative logic in the development of cooperation, taking into account reputation, and some gender-related differences probably associated with patterns of covert female competition. This similarity could have two additional explanations:

In the first place, participants are offered cooperative situations composed of common goals by these virtual settings, role development, distribution of mutual functions and expectations, that vary from real interactions in presentation but that, by keeping these elements, pose situations of mutual help which probably require displaying skills, even resulting beneficial to people on the autism spectrum by decreasing their feelings of loneliness and friendship perception (Sundberg, 2018). On the other hand, participants in this study belong in a generational category called “digital natives”, meaning that, for them, videogames could be regular socialization spaces, so as to not perceiving major differences with real interactions.

For some time now, there has been a remarkable concern about the effect of videogames on behavior and field results proved to be polemic. In a meta-analysis conducted by Greitemeyer and Mügge (2014), in which 98 independent studies were taken for a total of 36965 participants, a significant association with behavior in a real social setting was found in violent as well as in prosocial videogames. Even in violent videogames involving certain prosocial strategies, such as saving others or having to work as a team to attack a common rival, there seems to be a mediation of prosocial cognitive skills such as empathy, that end up being antagonists of aggressive responses, attenuating them. Therefore, it is viable to think that the elements taken into account to take part in cooperative tasks in the real world—among them reputation—also result relevant in virtual settings interactions.

Tendency as relevant information for minors to identify reputation

A proposal made by Barclay (2015) confirms that reputation is composed of variables such as skill, availability and tendency, so that the value of a cooperative partner is some sort of conjunction between these three characteristics: a good partner has the ability to help, is available to help at the present time and could do it in the future, as it is their behavioral pattern. A bad partner is quite the opposite; an intermediate partner is that who possesses intermediate values in all three characteristics, or has high levels in some but low in others.

However, the present investigation shows that minors, regardless of the group they were classified in, did not take into consideration skill and availability information to judge the reputation of a potential game partner, much less to decide to share or not. Tendency does appear as a distinctive sign of reputation to them, indicating that they are evaluating the inclination to cooperate further than their interaction partners; under a possible premise that people who are cooperative in a group could be also in other groups.

Unlike signs of skill, which could fluctuate due to the cost implied in displaying them in contexts of variable difficulty (a person could be skilled in one context and not in another), and signs of availability with the same cost for all individuals without categorizing them based on skills or resources, as they only inform that the potential partner is present; signs of tendency are relatively accurate, while these are displayed according to the benefits that short-term and long-term actions bring. A possible cooperation in the present time seems to foresee a future cooperation, as it is a personality trait and not a product situational circumstances. This generalization about tendency seems to mostly grab the minors' attention and result more informative than the others about the character's reputation.

Limitations

The present study presents an approximation to sharing cooperative behavioral development in virtual settings, comparing three stages in the life cycle and the use given to reputation information of potential game partners. To delve into the phenomenon it is necessary to conduct longitudinal research intrasubject analysis, so as to see how the same individual modifies the use given to reputation information to share. It is also necessary that virtual and real interaction settings are compared, in order to confirm that the similarities hypothesized in the present work are maintained.

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