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**Final dissertation**

**Infant sounds' emotional processing in mothers: is the  
alloparental model involved?**

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## Table of contents

<b>Abstract</b> .....	<b>3</b>
<b>1. Introduction</b> .....	<b>4</b>
1.1 Parenting.....	5
1.2 Infant Cry.....	6
1.3 Alloparental Care.....	7
1.4 Emotional Response to Infant Cry.....	8
1.5 Goals and Hypothesis.....	9
<b>2. Methodology</b> .....	<b>10</b>
2.1 Participants.....	10
2.2 Procedure.....	10
2.3 Analysis and Results.....	15
<b>2. Discussion</b> .....	<b>19</b>
2.1 Limitations.....	20
<b>4. Conclusion</b> .....	<b>20</b>
<b>5. Bibliography</b> .....	<b>21</b>

## **Abstract**

The following study investigates the influence of previous experience of care towards new-borns that are not biological relatives, also known as alloparental care, on the emotional processing of infant cry in mothers. Existing research on this topic does not include the variable of past experience of care and variables of psychological dimensions of care, which this study wants to examine. Several factors that influence the emotional processing of infant cry were considered, for example individual differences in depression and anxiety levels, sensitivity to noise, interpersonal reactivity, caregiving system, alexithymia, and difficulties in regulation of emotion. Participants were 55 mothers of age between 18 and 45, and the research consisted of two phases. The first phase was an assessment of psychological well-being, demographic data and an interview on past experience of care through self-report questionnaires. The second phase consisted in a behavioural task in which participants were asked to listen to different length infant cries and report their reaction to each cry through a questionnaire which investigated four dimensions of care: desire of closure, desire of communicating, sense of care and urgency of care. We used measures of correlation analysis and regression analysis. Results showed that the four dimensions of care are reciprocally correlated, meanwhile past experience of care towards non-biologically related children, preceding mothers' actual parental role, only partially contributes to a care-oriented psychological response of mothers to infant cries. In fact, past experience of care shows a significant effect only when mothers listen to cries of medium length (around 10 seconds). This research shows that the emotional processing of infant cry in mothers cannot be predicted solely by past experience of care, but other variables of individual differences must be considered. Further studies could implement these variables in the analysis of the data to broaden our understanding of this topic.

## **1. Introduction**

The relationship between infant's cry and several types of responses from parents and non-parents has been a subject of study for a considerable amount of time in the last and present century. Researchers explored this relationship with regard to characteristics of cry acoustics (Green et al, 1987; Zeifman, 2004; Leger et al, 1996); Fleming et al (2002) focused on the hormonal influence of testosterone and prolactin on the emotional response to infant's cry in new fathers, meanwhile others explored the relationship with regard to maternal sensitivity and social support (Kivijarvi et al, 2004) and maternal sensitivity in mothers with conflict and depression (Donovan et al, 1998); Zeskind (1992) studied the effect of the duration of pauses between cries and of expiratory sounds on adult's perception of urgency in the infant's cry; Irwin (2003) examined whether perceivers can detect distress in the visual and acoustic signals within the cry. The research that this thesis puts forward regards the examination of another variable: the presence of alloparental care experience. Specifically, the study examines the influence of alloparental care experience in the emotional response of mothers to the sound of infant cry. We hypothesize that the presence of alloparental care experience affects the emotional response by acting as a protector: it reduces the perceived and felt stress in relation to the stimulus of the infant cry. Moreover, we hypothesize that past experience of alloparental care can contribute to predict a response of care from the mother to the crying child. Some questions arise from the topics of parenting, child cry, alloparental care and emotional response. Are these elements related in any way to one another? Is there a connection between how we respond to an infant cry and our perception of how others cared for us? Do we all react to a crying child the same way? How many factors influence a person's, and especially a mother's, emotional processing

of an infant cry? To date no research has been conducted regarding the relationship between alloparental care and emotional processing of infant cry.

## **1.1 Parenting**

The U.S National Library of Medicine defines parenting as “performing the role of a parent by caregiving, nurturance, and protection of the child by a natural or substitute parent. The parent supports the child by exercising authority and through consistent, emphatic, appropriate behaviour in response to the child’s needs.” In her book “La funzione genitoriale. Sviluppo e psicopatologia” (2014), Simonelli states how in the last 25 years there has been a shift in the view of the development of the child and of the psychopathology, viewing the relationship between parents and child as a building factor for the internal world and the interpersonal skills during the life cycle of the child. Simonelli also states: “[...]Pathology during development, and especially during the first years of life, is reconsidered as an expression of a relational failure.” She emphasizes how, even though there are cases in which either the child or the parent are pathological in a way that disrupts the functioning of the relationship, which causes instances of maladaptive behaviour, these conditions are intrinsically intertwined and influenced by the context. In particular, many variables influence parenting, for example: individual and relational history of the person, the quality of the couple relationship, the quality of the enlarged family relationships and the social network of belonging and, last but not least, the quality of the inclusion of the subject in the broader context linked to the working sphere, culture and community. Belsky’s model of transitioning to parenthood (1984) schematizes these relationships. In Belsky and

Rovine's article "Patterns of Marital Change across the Transition to Parenthood: Pregnancy to Three Years Postpartum" (1990), it's pointed out that the ways married couples change after having a child are determined by multiple factors that can be identified before the infant is born. They also examined how postnatal information about child temperament improved the capacity to "discriminate marriages that declined and improved in quality across the transition to parenthood." Their research had to take into account plenty of variables in order to be externally valid, and what this means is that studying parenthood is so difficult because of all the factors that influence the role, both personal and related to the context.

## **1.2 Infant Cry**

In this study, we used a particular stimulus to examine the emotional processing of mothers: infant crying. Crying is a natural and spontaneous action that infants perform, and many studies suggest the developmentally necessary function of crying, for example infant's crying and fussing behaviour as a social signal serves as a form of communication between the infant and the mother (St James-Roberts, Conroy & Wilsher, 1995). During birth, the infant experiences air for the first time, and crying is proven to be of necessary importance to successfully performing the first breath. If a baby cries immediately after birth, it means the baby is healthy (Morley, Why Do Babies Cry? The Anatomical and Physiological Changes During the Moments After Birth, 2002). During the first year, or until the baby learns to communicate with the caretakers via gestures or finally words, crying is the main way in which infants communicate and attract attention from the caretakers. Crying has a useful and natural aspect to it, but it can also indicate an excessive stress, and should be accurately assessed by the caretaker, to which the infant is directly correlated to and by which

he/she depends. The correct response to the infant's cry is mandatory for the successful and healthy development of the child. The relationship that the caretaker, especially the mother, forms with the infant is of crucial importance for the development of a functional attachment style across the lifespan (Bowlby & Ainsworth, 1991). Infant crying has an emotional effect to everybody, even non-parents. Animals are naturally predisposed to detect and respond to infant's cries (Rilling and Young, "The biology of mammalian parenting and its effect on offspring social development," 2014; Newman, "Neural circuits underlying crying and cry responding in mammals", 2007), but then during parenthood this predisposition is also expressed directly. Alongside this general predisposition, everybody has individual differences in the emotional and cognitive response to infant's cries. The crying of an infant resonates with people's feelings and that is why some people cannot stand hearing a child cry, while others are touched and want to take care of the child. In our study we consider these individual differences.

### **1.3 Alloparental Care**

Alloparental care is defined as the acting out of those behaviours that ensure survival, protection and nourishment from parents and non-parents towards new-borns that are not biological relatives or that are even from another specie (Stead, Mucha, and Bădescu, 2019). In humans, people that take the role of alloparents are usually family members like grandparents, aunts and uncles, or sometimes older brothers and sisters. Research have shed the light on the theme of alloparental care, for example Snowdon (2017) examines paternal and alloparental care from the perspective of Niko Tinbergen's (1969) four main questions of behavioral research: phylogeny, adaption, ontogeny, and mechanism. Of significant importance is the study by Rosenbaum, Kuzawa, McDade, Bechayda and Gettler (2022) that examines whether environmental

unpredictability or harshness predict reliance on alloparental care among families in Cebu, Philippines. Again Martin, Ringer, Dida and Jaeggi (2020) conducted a study on the effects of harsh environments on the promotion of alloparental care across human societies. Alloparental care comprehends two or more subjects: one or more in need of care, and one or more able to provide that care. Subjects in need of care can be children, elder people, people with disabilities and hospitalized or home-bound people. One reason that can explain alloparental actions can be identified in altruism. For instance, Preston, in “The origins of altruism in offspring care. Psychological Bulletin (2013)” cited how “Altruistic responding is most salient during heroic acts of helping but is also observed any time one perceives another’s distress or need, which in turn motivates one to help at a current cost to the self.”

#### **1.4 Emotional Response to Infant Cry**

Hearing a child cry is something that we have all experienced in our lives. A crying child becomes immediately the centre of attention of everyone around. A set of emotions is activated in the minds of the listeners, and some people might even feel the urge to intervene and soothe the child, while others feel upset and just want to flee or the child to stop crying. Research has gone to great lengths in studying the factors that influence people’s emotional response to infant cries. Donovan, Leavitt and Walsh (1998) have studied the effects of variables “conflict” and “depression” on maternal sensitivity to infant cries. They found that variables like home/work conflict, marital happiness and maternal depression predicted sensitivity. Another study by Zeskind, Klein and Marshall (1992) examined for the first time how “variations in the temporal structure of infant crying differentially affect adults’ perceptions [...]”. Another study found data that supports that “infant age, and its associated acoustic features, seems to



be more important determinants of adults' perception of emotion intensity than are such adult characteristics as gender or infant-care experience." (Leger et al, 1996).

Testosterone and prolactin levels are important variables in the emotional response to infant cries in new fathers (Fleming, Corter, Stallings, and Steiner§, *Hormones and Behaviour*, 2002). Parallel to how parents' psychosocial variables influence their perception of infant cries, research also studied how infants' cries themselves predict different perceptions in parents. Zeifman (2004) conducted this type of study, finding from their data that during a healthy baby's crying bout, "a shift to longer duration of cries, and not cries of higher frequency, is associated with increased likelihood of caregiving intervention."

### **1.5 Goals and Hypothesis**

The goal of this thesis is to study whether, in mothers, past experience of care towards the other (alloparental care) and the quality of the care received from others (for example parents), contribute to predicting prosocial psychological dimensions related to care in response to infant cries of different length, in particular towards a sustained, potentially aversive cry. The study retrieves data about the participants' individual differences in depression and anxiety levels, sensitivity to noise, interpersonal reactivity, caregiving system, alexithymia, and difficulties in regulation of emotion. Participants take part to an ad-hoc built interview that assesses demographic data and direct or indirect previous experience (PrEx) of infant assistance. The main question that this study tries to answer is whether mothers' past experience of care (received and/or given) predicts how they will react in response to hearing an infant cry, specifically by increasing their desire to closure, desire to communicate, sense of care and urgency of care (Bornstein et al., 2019). A further point of examination is the

regression of the first hypothesis: can we determine the presence of past experience of care from the analysis of data that comes from mothers' emotional processing of the infant cry? One preliminary analysis is to determine whether the four psychological dimensions of care are correlated to one another. Our hypothesis is that past experience of care (PrEx) is correlated to higher levels of the four dimensions of care in mothers and that by assessing these dimensions we can infer the presence of past experience of care in mothers.

## **2. Methodology**

### **2.1 Participants**

Fifty-five mothers of ages between 18 and 45 (mean 37.3), of which three were excluded because restrained from completing the research, each with the youngest children of ages between 1 and 5, all Italian and married. Participants that present neurological conditions and/or disabilities precedingly diagnosed by a professional that could influence their capacity to complete the assessment were excluded. Pregnant women were also excluded from the study. Participants were recruited by means of flyers and word-of-mouth. Participants were asked to sign an informed consent before starting the experiment.

### **2.2 Procedure**

#### **Psychological assessment**

Using an online interview, we proceeded with the assessment of the psychological well-being of the person through self-report methodologies, we gathered anamnestic and sociodemographic data, and evaluated the grade of the subject's direct experience in professional and/or relational contexts of care of the other, with special reference to

childcare, through a series of ad-hoc built questions.

### **Psychological Measures**

- **Beck Depression Inventory (BDI-II)** (Beck et al., 1996) – depressive symptoms severity index. 21-question multiple-choice self-report used to measure an index of the presence and severity of depressive symptoms in two areas: somatic-affective (sleep, appetite and energy alterations) and cognitive (pessimism, sense of guilt, self-critic). The expected duration for the compilation is approximately 2 minutes.
- **State Trait Anxiety Inventory – form Y (STAI-Y)** (Pedrabissi, Santinello, 1989). Anxiety risk: 20-item questionnaire used to evaluate the symptomatology of state and trait anxiety. Duration of compilation: 2 minutes.
- **Individual Sensitivity to Noise (ISN)** (Senese et al., 2012) – Individual reaction to noise. 21-item scale used to assess the individual reaction to general noise and to daily environmental sounds. The expected duration for the compilation is approximately 2 minutes.
- **Interpersonal Reactivity Index (IRI)** (Davis, 1980) – Personal distress. 7-item scale used to measure feelings of fear, apprehension and discomfort experienced by the individual as a consequence of negative experiences lived by others. The expected duration for the compilation is approximately 2 minutes.
- **Caregiving System Scale (CSS)** (Shaver, Mikulincer, & Shemesh-Iron, 2010) – 20-item scale used to assess the tendency to activate and deactivate the care system towards another person. The expected duration for the compilation is approximately 2 minutes.
- **Toronto Alexithymia Scale (TAS-20)** (Bagby et al., 1994) – 20-item scale used

to assess the difficulty to identify feelings, express feelings to others and the cognitive style oriented to the exterior. The expected duration for the compilation is approximately 2 minutes.

- **Difficulties in emotion regulation scale (DERS)** (Gratz and Roemer, 2004) – Emotion regulation. 36-item scale used to measure the capacity to regulate negative emotions. The expected duration for the compilation is approximately 2 minutes.
- **Interview built *ad hoc*:** demographic data and direct or indirect previous experience (PrEx) of infant assistance. The expected duration for the compilation is approximately 3 minutes. Example of items:
  - 1) Do you currently find yourself in situations where you are asked to take care of one or more children?
  - 2) Have you ever been in situations in the past where you were asked to take care of one or more children?
  - 3) What kind of relationship is / was there with the child (children) you are / were taking care of?
  - 4) Do you currently find yourself in situations where you are asked to take care of one or more adults?
  - 5) Have you ever been in situations in the past where you were asked to take care of one or more adults?
  - 6) How long have you been taking care of this person(s)?
  - 7) How many hours a week?
  - 8) The treatment required of you is of the following type:
    - direct (hygiene, food) • indirect (time spent together) • both

- **Parenting Stress Index – Short Form (PSI-SF)** (Abidin, 1995) – questionnaire designed to identify stressful parent-child relational systems, therefore at risk for the development of both dysfunctional parenting behaviours and behaviour problems on the part of the child.
- **Early Childhood Behaviour Questionnaire (ECBQ) – Very Short** (Putnam et al, 2010) – questionnaire completed by the parent for the evaluation of the infant's temperament.
- **Interview built *ad hoc*:** direct or indirect experiences of caring for your child. The expected duration for the compilation is approximately 5 minutes.

Example of items:

- 1) During the day how much time do you spend playing with, talking or reading to your child (children)?
- 2) In what percentage are you responsible for preparing your child (children) to go to bed, to school or for other activities?
- 3) During the day how much time do you spend teaching your child (children) things about the world (outside of school context)?

## **Experiment**

### **Auditory stimulus**

The auditory stimuli that were used during the experiment are infants' crying sounds of different lengths (5, 10 and 35 seconds). Sounds chosen for the cry (IC) belonged to infants until the first year of life and are taken from public databases (es.

<https://www.sounddogs.com/>, [soundbible.com/](https://www.soundbible.com/), <https://www.audio4fun.com/> and

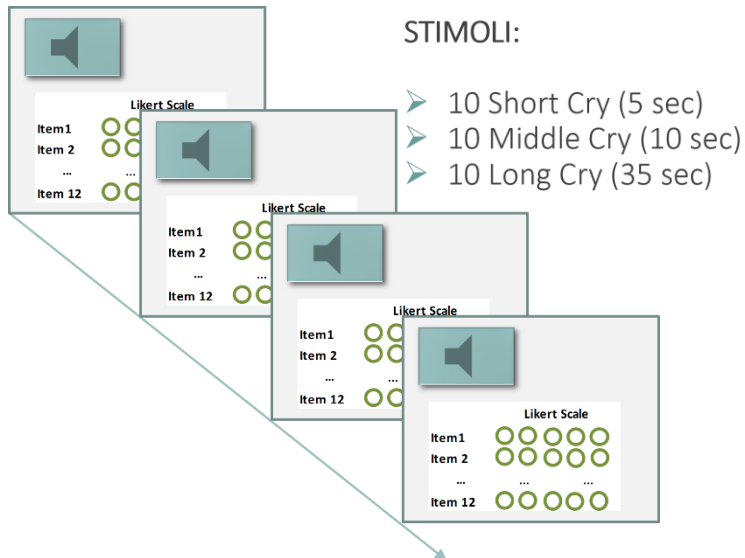
<https://freesound.org/>.. The volume of all the acoustic stimuli has been normalized. All

the stimuli have been modified using the software Audacity 2.1.0

([www.Audacity.sourceforge.net](http://www.Audacity.sourceforge.net)) and Adobe Audition CC 2015 (Adobe Systems

Incorporated, <http://creative.adobe.com/products/audition>).

**Figure 1**



### **Behavioural task**

Participants will be asked to listen to randomly displayed infants' negative vocalizations of variable lengths: short (5 secs), medium (10 secs), and long (35 secs). Each category consists of ten different sounds. Participants will be asked to evaluate each sound with respect to the perceived personal discomfort, the discomfort expressed by the negative vocalization, and four psychological dimensions that refer to the desire of closure, desire of communicating, sense of care and urgency of care (Barnstein et al., 2019). The task took approximately 30 minutes.

There are no ethical risks contemplated: no manipulation is foreseen, all the relevant

information will be made available to the participants before the experiment and the possibility of withdrawal in any moment without giving any explanation and without incurring any kind of penalty will be explicated, and in that case the data will simply not be used. The participant, if wished, can ask for the return of the raw data, the interpretation of which can be asked to a clinician.

The research will be conducted via zoom, where the researcher and the participant will use their own pc.

## 2.3 Analysis and Results

### Descriptive

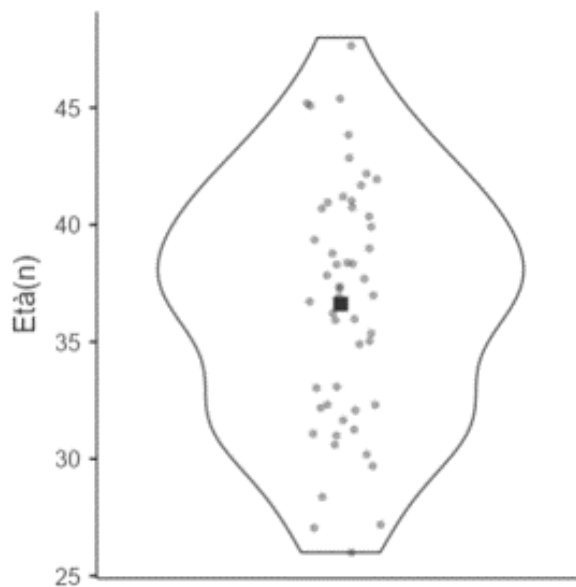
**Table 1**

	<b>ChildPresent_Exp</b>	<b>Age(n)</b>
N	no	37
	yes	15
Mean	no	36,8
	yes	36,3
Standard deviation	no	4,78
	yes	6,39

Three out of the fifty-five mothers that took part of the experiment did not complete all the tasks. Their data were excluded. Of the fifty-two mothers that completed all the tasks, 37 had no past experience of alloparental care (PrEx) and 15 had PrEx. The mean age of mothers with PrEx is 36.3, standard deviation 4.78, meanwhile the mean age of mothers without PrEx is 36.8, standard deviation 6.39 (**table 1, figure 1**)

### Preliminary correlations

**Figure 1**



**Table 2**

	<b>ChildPast_Exp</b>	
	<b>yes</b>	<b>no</b>
<b>Durata</b>		
<b>Pianto</b>		
<b>PARQ (padre)</b>	1.62	1.54
<b>PARQ (madre)</b>	2.05	1.96

	<b>Età</b>	<b>Esperienza Cura</b>
<b>Età(n)</b>	—	—
<b>Esperienza Cura</b>	-0.268	—
<b>PARQ (padre)</b>	0.17	0.046
<b>PARQ (madre)</b>	-0.029	0.053

*Note.* \*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$

We carried out a first correlational analysis and found no correlation between age and PrEx ( $r = -0.268$ ), and between mothers' PARQ scores and age ( $r = -0.029$ ), meanwhile we found correlation between mothers' PARQ scores and PrEx ( $r = 0.053$ ), and fathers' PARQ scores and both age and PrEx ( $r = 0.17$  and  $r = 0.046$ ) (**table 2**).



We conducted a **correlational analysis** to examine if and how the four dimensions of care relate to each other. Data showed that the four dimensions correlate reciprocally. These four dimensions were then considered as one single variable of care (prosocial behaviour) by using the mean of their scores. (**table 3**)

**Table 3**

		1	2	3	4	5	6	7	8	9	10	11	12
<b>Desiderio di avvicinarsi</b>	1 SC	—											
	2 MC	0.913 ***	—										
	3 LC	0.798 ***	0.79 ***	—									
<b>Desiderio di comunicare</b>	4 SC	0.872 ***	0.837 ***	0.716 ***	—								
	5 MC	0.801 ***	0.868 ***	0.671 ***	0.906 ***	—							
	6 LC	0.586 ***	0.585 ***	0.705 ***	0.721 ***	0.773 ***	—						
<b>Senso di cura</b>	7 SC	0.902 ***	0.854 ***	0.743 ***	0.927 ***	0.855 ***	0.629 ***	—					
	8 MC	0.835 ***	0.892 ***	0.728 ***	0.875 ***	0.913 ***	0.679 ***	0.919 ***	—				
	9 LC	0.725 ***	0.676 ***	0.86 ***	0.722 ***	0.646 ***	0.718 ***	0.779 ***	0.774 ***	—			
<b>Urgenza di cura</b>	10 SC	0.848 ***	0.807 ***	0.665 ***	0.713 ***	0.702 ***	0.445 ***	0.761 ***	0.713 ***	0.563 ***	—		
	11 MC	0.82 ***	0.871 ***	0.678 ***	0.702 ***	0.744 ***	0.45 ***	0.733 ***	0.786 ***	0.582 ***	0.924 ***	—	
	12 LC	0.756 ***	0.703 ***	0.877 ***	0.626 ***	0.585 ***	0.64 ***	0.651 ***	0.623 ***	0.783 ***	0.765 ***	0.747 ***	—

Note. \* p < .05, \*\* p < .01, \*\*\* p < .001

## Regressions

### Analysis: predictors of adult care (prosocial behaviours) elicited by short, medium and long infant cries

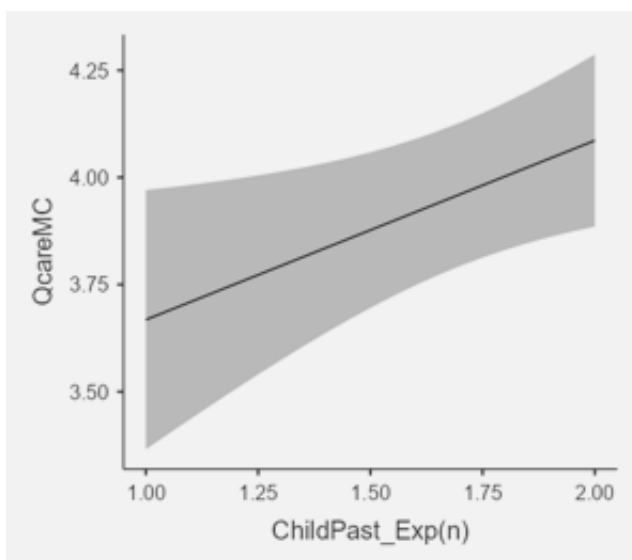
Next, we carried out a regression analysis (R1: short cry; R2: medium cry; R3: long cry) to investigate if perceived parental care (PARQ: father and mother) and previous experience of alloparental care to children (PrEx) can predict adult care (prosocial behaviours) elicited by short, medium and long infant cries (dependent variables).

Regression models R1 and R3 were not significant.

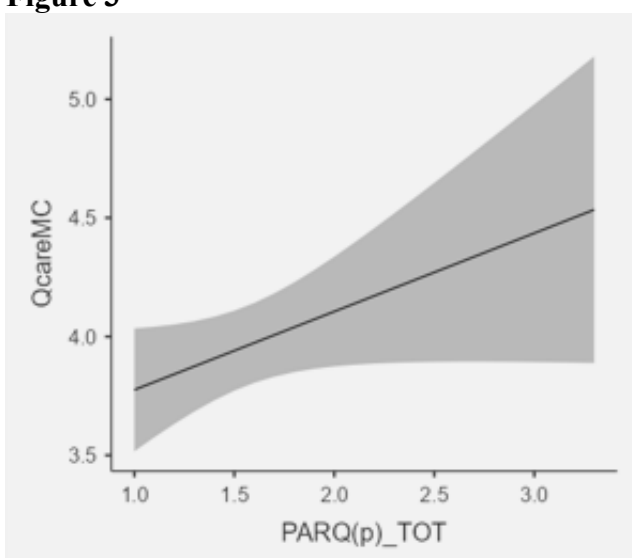
### (R2) Medium Cry (MC)

The model explains a significant proportion of the variance of scores of prosocial behaviour elicited by the cry, Adjusted R2 = 0.13,  $F(3, 45) = 42.64$ ,  $p < .027$ . Past experience of care produces a significant increase of the dependent variable (prosocial behaviour),  $\beta = 0.31$ ,  $t = 2.32$ ,  $p < .025$ . Mothers' and fathers' PARQ are not significant predictors, although fathers' PARQ shows a tendency to significance (**figure 2 and 3, table 4**).

**Figure 2**



**Figure 3**



**Table 4**

Predictor	(B)		95% Confidence Interval		t	p	(β) Stand. Estimate
	Estimate	SE	Lower	Upper			
Intercept	2.8457	0.402	2.0365	3.655	7.082	< .001	
PARQ(p)_TOT	0.3299	0.177	-0.0269	0.687	1.862	0.069	0.3238
PARQ(m)_TOT	-0.0543	0.149	-0.3536	0.245	-0.366	0.716	-0.0636
ChildPast_Exp(n)	0.4181	0.18	0.055	0.781	2.319	0.025	0.3127

### 3. Discussion

This research had its primary focus on investigating the effect of past experience of alloparental care on mothers' emotional processing of the infant cry. Specifically, we were interested in corroborating the hypothesis that past experience of alloparental care increases the level of prosocial behaviour elicited by the infant cry. Measures of correlational analysis and regression analysis showed us that prosocial behaviour characterized by psychological dimensions related to care, namely the desire to approach, desire of communicating, sense of care and urgency of care are only partially predicted by a measure of past experience of alloparental care. Only cries of medium length (ten seconds) showed to fit our model ( $p = 0.025$ ). We also saw how, in our sample of mothers, a measure of acceptance/rejection perceived from their fathers shows a tendency to be significant in the way mothers process the infant cry ( $p = 0.069$ ).

One consideration is that the expression of care behaviour by a mother, and a person in general, towards a crying infant is influenced by more factors and cannot be explained solely by the amount of experience of care towards others that a person has. It also cannot be explained solely by the care that they perceived from their parents. In this

study we cited some of the most important factors that influence this behaviour, and a further study should include measures of these variables, namely individual differences like depression, anxiety, stress, social and marital relationships, influence of the context and of the working environment.

### **3.1 Limitations**

Limitations to our study were related mainly to the sample size, and to factors of low external validity considering that the study was conducted in laboratory settings, where mothers had no direct contact with the infants, the context in which infants were crying was not displayed and therefore many variables related to the context were missing. In order to comprehend the level of distress in the infant's cry, it's necessary to consider contextual aspects, because vocalizations assume meaning only if they're contextualized (Gustafson et al, 2000). Another limitation was the lack of time quantification with regards to mothers' past experience of care, meaning that we have not measured the frequency or the continuity in time in which the participants took care of others. Another limitation regarding the stimuli is the lack of characteristics of the infants, like age. Finally, we did not have measures of the type of relationships that the participants had with the person(s) they took care of, whether it was personal or professional.

### **4. Conclusion**

This study presents itself as a starting point for a set of research that can lead to important discoveries about the variables that determine the way people act out behaviours of care. The narrow focus of this study led to an understanding of the role of past experience of alloparental care in the processing of infant cries, while it also led to

the understanding that much research is still needed to fully comprehend the variables at play. For example, the next study should investigate the construct of interest in ecological settings, outside of the laboratory, like homes or playgrounds, where the infant cry can be studied in its natural expression. Further studies should also differentiate between primiparous and multiparous mothers to control variables of experience with children. Lastly, conducting a study with a wider sample would also be recommended, in order to account for temperamental aspects of the child and the caregiver and broaden our understanding of the complex interactions between these factors.

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