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## **KNOWLEDGE SHARING IN SOCIAL INTERACTION: TOWARDS THE PROBLEM OF PRIMARY DATA ENTRY**

### **Abstract**

The article studies a gap in current knowledge of the so-called problem of primary data entry (PDE) by reviewing relevant theories on emotional contagion and empirical data obtained from experiments on crying in newborns (Geangu et al., 2010; Dondi et al., 1999; Martin & Clark 1982; Sagi & Hoffman 1976; Simner 1971). This paper highlights the critical properties of emotional contagion and empathy for further discussion on the differences of their appearance and evolutionary advantage. This discussion article concludes that emotional contagion can happen without awareness of the existence of emotional stimuli, as people are able to recognize the emotional state of others without even knowing about the existence of other people's emotional expressions (Tamietto et al., 2009). Emotional contagion is likely an essential trigger in solving PDE. The article discusses: (a) Even if newborns possess an innate repetition mechanism, the problem of PDE makes imitation meaningless that may not promote the cognitive development in infants. (b) Whether emotional contagion transfers meaningful content even being occur without self-awareness. (c) Whether emotional contagion contributes to beginning of knowing in newborns. (d) Whether emotional contagion in newborns challenges knowledge about social interaction. Given these observations, emotional contagion in mother-newborn dyads could be considered a manifestation of the mental coherence that unconsciously provides intentionality in acquiring social meanings. We propose further research considering this effect of non-perceptual social interaction as a manifestation of another modality of social interaction that promotes the shaping of social reality in newborns and social learning at the beginning of life..

**Keywords:** Social cognition; imitation; empathy; emotional contagion; social interaction; problem of primary data entry.

### **INTRODUCTION**

Understanding social reality is essential for individuals to perform immediate reactions and strategic planning in environments with many rapidly changing elements. Brains provide an evolutionary advantage for survival by allowing organisms to extract information patterns that aid predictions (Prochazkova &

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Kret, 2017; Adolphs, 2001). The latter is grounded on the ability to capture mental states from other individuals, which promotes social cooperation and competition.

This ability is present from birth or even earlier; however, the main problem is that newborns possess a very limited set of tools for acquiring social knowledge. Therefore, this review's fundamental question is focused on how infants can capture initial knowledge about the social reality, which is the question of social interaction modalities. This study observes the current definitions of emotional contagion and empathy, analyzing empirical data from other studies. Then the article discusses different hypotheses of emotional contagion, highlighting the critical properties of emotional contagion and empathy for further discussion on the differences of their appearance and evolutionary advantage.

## **EMOTIONAL CONTAGION VS EMPATHY**

The meaning of a word is defined by its use (Wittgenstein, 1973). Barrett's (2006) paradox of emotion determination noted the inconsistency between the experience of emotions (like "anger", "sadness", and "happiness") and psychophysiological and neuroscientific data that failed to provide consistent evidence for the existence of such discrete categories of experience. In addition to challenging many theories of emotions, this paradox also highlights the difficulty of defining and distinguishing different emotional experiences, as the definition of any concept of emotion is grounded on its components: the modality of the phenomenon described by this concept, its etymology and modern usage of this word use (consensus). Moreover this problem requires both semantic competence to differentiate the meaning of a word in modern usage, and the analysis of relevant empirical data on the modality of the phenomenon. The two concepts – emotional contagion and empathy – can produce similar and/or indistinguishable manifestations in adults, while their appearance in childhood allows to mark visible borders between them. The literature defines primitive emotional contagion as the tendency to take on the sensory, motor, physiological and affective states of others, or in other words, as to automatically mimic and synchronize expressions, vocalizations, postures, and movements with those of another person's and, consequently, to converge emotionally (Hatfield et al., 1993). It is already widely argued that primitive emotional contagion is a building block of social interaction, assisting in capturing mental states of others and contributing to cognition. Scholars from a variety of disciplines – neuroscience, biology, social psychology, sociology, and life-span psychology – have proposed that primitive emotional contagion is of critical importance in understanding human cognition, emotion, and behavior (Hatfield et al., 1993). This analysis sustains the general definition of this concept noting the fact that

emotional contagion is sharing emotion without self-awareness (Decety & Jackson, 2004) and it operates automatically (Heyes, 2018) from the birth.

According to the APA Dictionary of psychology (n.d.) empathy is understanding a person from his or her frame of reference rather than one's own, or vicariously experiencing that person's feelings, perceptions, and thoughts. Empathy does not, of itself, entail motivation to be of assistance, although it may turn into sympathy or personal distress (APA Dictionary of psychology, n.d.). Empathy is the emotional responsiveness which an individual shows to the feelings experienced by another person; the ability to identify with another's emotions and understand what they are feeling (Hoffman, 2000). Empathy requires three distinct skills: the ability to share the other person's feelings, the cognitive ability to intuit what another person is feeling, and a "socially beneficial" intention to respond compassionately to that person's distress (Decety & Ickes, 2011; Decety & Jackson, 2004). According to Hoffman (2000) everyone is born with the capability of feeling empathy. Therefore empathy itself is an ability which is developed within the framework of social norms and rules. For this reason empathy is to be considered a social construct. Instead of emotional contagion, empathy requires the understanding of the social reality and the mental state of others before expressing it.

Newborns are able to get the emotional state of others without self-awareness through emotional contagion, while they are not able to demonstrate the actual skill of empathy. That would imply intuitively understanding what the other individual is feeling and responding compassionately to that person's distress. Empathy requires first a much more developed mind than the one infants possess at the early stages of cognitive development. Secondly it requires the understanding of a minimum set of social phenomena necessary to comprehend social rules and norms that correspond to this skill. Similarity in the manifestations of these two phenomena should not lead to suppose a similarity in their modes, or that 'emotional contagion is a form of empathy, albeit a non-insightful, primitive form (Yong & Ruffman, 2014)'. Moreover, the different outcome of these two phenomena allows us to discuss them as completely different mechanisms. In empathy, the emotional state of the observer may not correspond to the experience of the observee. For instance, an unjustified and inappropriate anger of the observee can cause the observer to sympathize in the form of compassion, but not a similar emotion like anger. The table 1 provides the comparison of emotional contagion and empathy. It seems that etymology and modern usage of these two concepts allows us to leave in this study the current definitions of emotional contagion and empathy. There is a lot of data in the literature on how to develop empathy in children, while there is a little consensus about the mechanism of emotional contagion. Therefore the next two sections review different studies on crying in newborns and 3-month-old infants to discuss the modality of emotional contagion.

## **EMPIRICAL DATA ON EMOTIONAL CONTAGION IN NEWBORNS AND INFANTS**

Newborns manifested a reaction to the crying of another newborn, which is a phenomenon that refers to emotional contagion (Dondi et al., 1999; Martin & Clark 1982; Sagi & Hoffman 1976; Simner 1971). Newborns responded more strongly to another infant's cry than to a variety of controlled stimuli, including silence, white noises, synthetic cry sounds, non-human cry sounds, and their own cry (Dondi et al., 1999; Martin & Clark 1982; Sagi & Hoffman 1976; Simner 1971). Geangu et al. (2010) show that during the presentation of a pain cry sound, 1- and 3-month-old infants manifest increased vocal and facial expressions of distress. This affect of shared reactions does not decrease with age. Both boys and girls manifest similar levels of contagious crying reactions (Geangu et al., 2010). This suggests that infant distress reactions to the cry of another infant are not simply a response to the aversive noise of the cry; rather it may be a very early precursor to empathic responding (McDonald & Messinger, 2011). This finding challenges the nativist models of emotional contagion and the constructivist ones due to the argument that sound can also possess a meaning. Sounds of objective reality are assigned with meanings, which individuals harvest and categorize throughout life (Danilov, 2020b). There are thousands of different social meanings that human ear can nominally hear in the limits from 0.02 kHz to 20 kHz. Categorization of social reality and cognitive development also depend on perception of world of sounds (Danilov, 2020b), e.g. the common situation for deaf children around the world is a serious delay in cognitive development (Peterson, 1995). These arguments above challenge our modern knowledge of how newborns are able to categorize social reality, taking into account their communication disability. The findings of studies on other various phenomena, such as facial recognition, Other Race Effect (ORE), and Other Species Effect (OSE) show similar efficiency of newborns in categorizing social reality. Their analysis evidently shows a discrepancy between the complexity of tasks and ability of infants to solve them (Danilov, 2020c). According to Danilov (2020c), these achievements of infants are possible only through their mental collaboration with adults. In the following sections, the study continues to discuss what can help newborns distinguish the sounds of other newborns crying from other social sounds and 'aversive sounds that do not express emotion (Ruffman et al., 2019)'.

## **SOME EXISTING MODELS OF EMOTIONAL CONTAGION**

The article reviews different models of emotional contagion:

(i) The Perception-Action Model of empathy (PAM) supports genetically inherited mechanisms of emotional contagion. Preston and de Waal, (2017; 2002) suggest that during the early evolution of mammals, when parental care was becoming important, and during primate evolution, when cooperation among group members was increasingly at a premium, natural selection favored genes promoting emotional contagion. This nativist view is supported by the growing evidence of emotional contagion in a range of species and they suggest that rapid, unintentional, adaptive responses are due to genetically inherited mechanisms (de Waal & Preston, 2017; Preston & de Waal, 2002).

(ii) The Active Intermodal Matching (AIM) suggests that an innate cognitive mechanism or 'body scheme' computes and detects similarities between observed and executed acts (Meltzoff & Moore, 1997). Infants' imitation implicates an innate 'common code of human acts' or 'supramodal' representation that provides transformations of acts between the self and the other (Meltzoff, 2002), linking the neural basis for common coding to areas involved in the mirror neuron system (Meltzoff & Decety, 2003). The central idea of the AIM is that observing the same movement in others enables self-generated movements which induce inherent meaning of the observed action (Prochazkova & Kret, 2017). That could mean newborns comprehend certain social case based on sensorimotor resonance from its own motor neurons and muscle movements. One of the problems of this method is that an identical movement may have several causes and goals in executors and multiple possible interpretations in observers (Prochazkova & Kret, 2017).

(iii) Associative sequence learning (ASL) proposes that infants can learn flexibly from their own environment (Ray & Heyes, 2011). The principle of ASL is based on an extensive learning (or conditioning) experience. This implies that infants need to see the action and perform the contingent action contingently (close together in time), in order to then imitate a mimic perceived action of a caregiver.

(iv) The Neurocognitive Model of Emotional Contagion (NMEC) supposes that autonomic responses of the sender directly modulate neural activity in the emotion system of the receiver. In line with the AIM, the NMEC argues that this form of emotional contagion is fast, automatic, shared by most vertebrates and does not require extensive training. Human infants possess an innate mechanism which automatically converts the sensory signals related to senders' autonomic states to their own corresponding autonomic states. The core idea of this method is when infants unconsciously mimic their caregiver's expressions of emotion,

they come to feel reflections of those emotions as well (Prochazkova & Kret, 2017).

(v) The Learned Matching (LM) hypothesizes that the automatic activation characteristic of emotional contagion depends on a set of learned associations (Heyes, 2018). Each of these matching emotional associations connects, in a bidirectional excitatory way, a distal sensory cue (e.g. an emotional facial gesture or vocalisation) with a motoric or somatic response belonging to the same emotional category (Heyes, 2018; Bird & Viding, 2014). According to Heyes (2018), these connections are forged in situations where the experience of a particular emotion 'from the inside' is correlated with observation of the same emotion 'from the outside'. Matching emotional associations for perceptually opaque cues are produced by synchronous emotion and affect mirroring (Heyes, 2018; Papousek & Papousek, 1987). Synchronous emotion occurs when two or more agents react emotionally to an event in the same way at the same time (Heyes, 2018). nowadays the world changes more and more rapidly. The 21st century society has entered

## **DISCUSSION**

Even though other models of emotional contagion also may attempt to understand this issue, although the ones considered above are already enough to show the gap in knowledge on the beginning of knowing, which is discussed below:

(a) The reason why newborns imitate is unclear. Apart from the PAM nativist model – that is grounded on the question of innate initial knowledge of certain social reality – other models (AIM; ASL; NMEC; LM) seemingly rely on social learning through imitation. This approach leave a gap in knowledge about how newborns can respond appropriately to an event in the same way as others. Imitation is a difficult task that requires understanding the meaning of the action and the intention to do so. How newborns perform this task is still unclear, given the lack of time and communication ability of newborns to learn from the social environment that they also need to repeat others. At the same time, empirical data on crying evidently show that newborns are able to solve this task. The subject learns behaviors through imitation and emotional contagion and cannot be therefore dissociated from others during the first months of life (Wallon, 1959; Keromnes et al., 2019). The intention of newborns to imitate is questionable: it is unclear whether infants repeat crying of other newborns (and/or caregivers' actions in the case of social learning of other skills) intentionally or not. If intentionally what is their reasoning behind this and if not what makes them do this. That means that why newborns imitate others (peers and/or their

caregivers) is still unclear. If the given reason for imitation is unclear, then there may be another, more reasonable cause for imitation than assimilation of emotion expressions. Moreover, existing data suggest that infants do not imitate purposely others until their second year, and that imitation of different kinds of behavior emerges at different ages (Jones, 2009). Or, in other words, there is no evidence that newborns imitate others on their own and/or are able to do so intentionally. Perhaps, the growing data of infants' imitation may indicate something else. This may be a manifestation of interaction between dyads of another modality, and imitation may not be a learning tool itself, but an integral part of the neurophysiological and mental process that promotes learning. Even if newborns possess an innate repetition mechanism, the problem of PDE makes imitation meaningless that does not promote the cognitive development in infants.

(b) Whether emotional contagion transfers meaningful content even being occur without self-awareness. In emotional contagion we have to consider meaning as the core. Emotional contagion does not arise only in dyadic or group face-to-face interactions but can occur when individuals only hear about emotions of others (Nummenmaa et al., 2014), and also in online interactions (Isabella & Carvalho, 2016). Growing evidence of emotional contagion in online interaction supports this standpoint. Even if one interacts with another person online and the receiver receives the message at a different time through verbal communication (for example via texts: letter, book etc.), it changes anyway the individual's mental state regardless the time the receiver receives the message. Emotions expressed by others on Facebook influence our own emotions, constituting experimental evidence for massive-scale contagion via social networks (Kramera et al., 2013). Despite their study may contain methodological difficulties and the chosen tools are too technical (since they are configured for a mass online survey), the outcome is consistent with the meaning of emotional contagion in social interaction, common sense and the generally accepted viewpoint of everyone on the life experience of emotional arousal from texts (letters, books, journals etc.) without direct social contact. Anyway, the effect size of the findings is large, the significance of which is also proved by the meaning of this coefficient for observing an obvious phenomenon. Moreover, there is no data on a stable compound that would accurately links the particular components: a specific motoric or somatic response, activation of certain neural circuits and a determinate emotion. Hickok (2009) argues that perhaps just like unconscious reflexes, mirror neurons do not code for any particular meaning or goal-directed action. Evidence shows that mirror system activation can be recoded with training such that it becomes associated with a completely different action (Catmur et al., 2007). This means simple similarity of movements and/or imitations does not prove the same meanings of these movements in individuals.



Therefore, given the above arguments, it seems that emotions are first a mental process and only second a complex of physiological mechanisms that transmit environmental stimuli impulses into the brain. It seems that, emotional contagion possesses meanings even being occur without self-awareness. This raises again the problem of PDE, how newborns deal with this interaction without understanding the social meanings.

(c) Whether emotional contagion contributes to beginning of knowing in newborns. The problem of primary data entry. The emergence of communication requires a shared understanding of the signal's meaning (i.e., uses) within a particular context among a community of users (Wittgenstein, 1973). Acquisition of knowledge implies some initial data, because new knowledge can be assimilated based on the discovery of new key relationships between cause and effect within previous knowledge, and/or opening links between elements of initial knowledge and new information domain (Danilov & Mihailova, 2019). This means that primary knowledge is crucial for the initial stages of cognitive development and even for assimilation of simple social tasks. While at the initial stages of the Model of Hierarchical Complexity (MHC) (Commons, 2016), newborns are not able to communicate with caregivers effectively enough to acquire first social phenomena (there is no evidence of any communication at three initial stages of the MHC). At the same time they are able anyway to successfully perform their social tasks (Danilov, 2020c). Therefore, the problem of PDE challenges modern knowledge. This is given the lack of data in genetics that supports some innate knowledge on a particular social reality that can be passed between generations to help newborns behave appropriately (Danilov, 2020b). Therefore assimilation of social reality by infants needs PDE, considering thousands different linguistic communities with their particular social reality which questioned any innate mechanism of social learning. Given above arguments it is likely that emotional contagion contributes to PDE, and imitation in infants promotes this.

(d) Whether emotional contagion in newborns challenges knowledge about social interaction. Emotional contagion occurs without self-awareness (Decety & Jackson, 2004) and can happen even without awareness of the existence of stimuli. Recent research tested subjects with unilateral destruction of the visual cortex and ensuing phenomenal blindness on invisible stimuli (Tamietto et al., 2009). According to Tamietto et al. (2009) emotional contagion occurs even when the triggering stimulus cannot be consciously perceived due to cortical blindness. This highlights the difference in the modality of emotional contagion and empathy, because the latter requires understanding the social reality and the mental state of others before expressing. These findings promote a new

approach to understanding of possible mechanisms of emotional contagion which challenges knowledge on social interaction.

## **CONCLUSIONS**

The models of emotional contagion (discussed in the review) are plausible. At the same time, the above arguments show that these models may not solve the problem of how the meaning of an observer's response relates to the meanings of a current social reality and the meaning of an executor's expression. In conclusion, emotional contagion is sharing emotion without self-awareness (Decety & Jackson, 2004) and it is a phenomenon that occurs from the birth. It operates automatically (Heyes, 2018) both in direct interactions and online modes. Emotional contagion can also happen without awareness of the existence of emotional stimuli, as people are able to recognize the emotional state of others without even knowing about the existence of other people's emotional expressions (Tamietto et al., 2009). It is likely that emotional contagion facilitates primary data entry. The phenomenon of newborns' reaction to the crying of their peers (Dondi et al., 1999; Martin & Clark 1982; Sagi & Hoffman 1976; Simner 1971) can be explained from this perspective.

The above arguments show that one of the possible explanation of the newborns' reactions to the crying peers is the mental collaboration with their caregivers. Infants do not understand the meaning of others crying on their own, but follow the caregivers' stimulation through emotional contagion. This conclusion also emphasizes the different modalities of emotional contagion and empathy. Emotional contagion in mother-newborn dyads is a manifestation of the mental coherence which unconsciously provides social meanings. On the other side empathy is an ability developed within the framework of social norms and rules, including comprehension of the social reality. These conclusions provide new directions for further research on the modality of emotional contagion and its connection with non-perceptual social interaction in knowledge sharing which processes from the birth throughout life.

## **CONCLUSIONS**

The models of emotional contagion (discussed in the review) are plausible. At the same time, the above arguments

## **AUTHOR CONTRIBUTIONS**

Igor Val Danilov formulated the hypothesis and wrote the first draft of the manuscript. Igor Val Danilov and Sandra Mihailova improved the text over several iterations.

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## TABLES

**The table 1.** The comparison of the concepts of emotional contagion and empathy

Emotional contagion (Empathy1)	Empathy (Empathy2)
<p><b>Modern usage:</b> Tendency to take mental states of others, or to automatically synchronize expressions (Hatfield et al., 1993); sharing emotion without self-awareness (Decety &amp; Jackson, 2004);</p>	<p><b>Modern usage:</b> The emotional responsiveness which an individual shows to the feelings experienced by another person; the ability to identify with another's emotions and understand what they are feeling (Hoffman, 2000). Empathy requires three distinct skills: the ability to share the other person's feelings, the cognitive ability to intuit what another person is feeling, and a "socially beneficial" intention to respond compassionately to that person's distress (Decety &amp; Ickes, 2011; Decety &amp; Jackson, 2004).</p>
<p><b>Definition in dictionary:</b> The rapid spread of an emotion from one or a few individuals to others (APA Dictionary of psychology, n.d.)</p>	<p><b>Definition in dictionary:</b> Understanding a person from his or her frame of reference rather than one's own, or vicariously experiencing that person's feelings, perceptions, and thoughts. Empathy does not, of itself, entail motivation to be of assistance, although it may turn into sympathy or personal distress (APA Dictionary of psychology, n.d.).</p>
<p><b>Modality:</b> It operates automatically (Heyes, 2018); it occurs without self-awareness (Decety &amp; Jackson, 2004) and without understanding social reality from the birth.</p>	<p><b>Modality:</b> It involves controlled processing, develops later, and, insofar as the controlled processing involves mindreading (Heyes, 2018); it requires understanding the social reality and the mental state of others before expressing.</p>
<p><b>Outcome:</b> The same emotional arousal in participants.</p>	<p><b>Outcome:</b> Understanding of other people mental state, compassion, benevolence, as well as satisfaction in accordance with social norms. The emotional state of the observer may not correspond to the experience of the observee. For instance, an unjustified and inappropriate anger of the observee can cause the observer to sympathize in the form of compassion, but not a similar emotion like anger.</p>

