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Collective emotion: an experimental framework

Victor Chung^{1,2}, Julie Grèzes^{2#} and Elisabeth Pacherie^{1#}

¹Institut Jean-Nicod, CNRS, EHESS, ENS, PSL Research University, Paris, France

²Laboratoire de Neurosciences Cognitives et Computationnelles (LNC²), INSERM U960, ENS, PSL
Research University, Paris, France

#Julie Grèzes and Elisabeth Pacherie should be considered joint senior authors.

Author Note

Victor Chung: <https://orcid.org/0000-0002-5198-501X>

Elisabeth Pacherie: <https://orcid.org/0000-0003-2337-581X>

Julie Grèzes: <https://orcid.org/0000-0002-5066-9154>

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Correspondence concerning this article should be addressed to Victor Chung, École normale supérieure, 29 rue d'Ulm, 75005 Paris, France. Email: victor.chung@ens.psl.eu

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Abstract

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A bustling literature spanning philosophy, psychology and social sciences aims for a better

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understanding of the collective patterns of emotions stirring human society. To date, however, this

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endeavour is still in need of a unifying conceptual framework and empirical evidence regarding the

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characteristics, antecedents and consequences of collective emotion remains sparse. To foster

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progress in the field, we examine existing accounts and identify three characteristics of collective

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emotion: emotion alignment, feeling of social connectedness and mutual awareness. We then

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propose a typology of collective emotion that accounts for the dynamic interplay of social and

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cognitive processes. Crucially, this typology allows for integrating different accounts and research

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traditions into an experimental framework that generates testable predictions regarding the

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mechanisms and consequences of collective emotion. Finally, we review available empirical evidence

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in social and cognitive sciences and we discuss future directions for an evidence-based approach to

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collective emotion.

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Keywords: collective emotion, shared experience, group emotion, interpersonal synchrony, social

15

cognition

16 Emotional gatherings are ubiquitous in human societies: crowds cheer in stadiums, friends
17 and relatives celebrate or mourn as a group, and online communities thrive on loving or hating
18 together (Turner & Stets, 2005). Despite many differences between these examples, humans exhibit
19 patterns of collective behaviour during these events: individuals chant, applaud in synchrony and
20 rally round to act in a coordinated fashion (Sumpter, 2006). Surprisingly, the study of collective
21 human behaviour has remained largely independent from research on the collective patterns of
22 *emotion* unfolding during these social gatherings. Yet, social interactions cause emotions and
23 emotions shape social interactions (Parkinson, 1996; Keltner & Gross, 1999; van Kleef et al., 2016):
24 humans express and convey emotions, influence each other and experience similar emotions. The
25 label 'collective emotions' is often used to refer to those emotions that individuals experience
26 together (Salmela, 2012). Given their central importance in human social interactions, it is crucial
27 that we gain a better understanding of collective emotions, their mechanisms and functions.

28 Collective emotion has aroused growing interest from researchers in social sciences,
29 psychology, and philosophy (von Scheve & Salmela, 2014). In this multidisciplinary domain, a
30 collective emotion is typically conceived of as a group-level pattern of emotional responses
31 (Goldenberg, 2020), whose function is to foster social cohesion and collective action (Collins, 2014;
32 Salmela, 2014; Salmela & Nagatsu, 2016). However, despite a rich and expanding theoretical
33 literature, there is no consensus on the nature, mechanisms and specific consequences of collective
34 emotion. To date, accounts rely on different conceptualizations of emotion, different levels of
35 description, different methods of investigation and different terminologies (for an overview see
36 Salmela, 2014 and von Scheve & Salmela, 2014). For instance, the terms collective emotion (Gilbert,
37 2002; von Scheve & Ismer, 2013; Salmela & Nagatsu, 2016; Schmid, 2017), group emotion (Smith et
38 al., 2007; Menges & Kilduff, 2015), shared emotion (Salmela, 2012; Thonhauser, 2018; Szanto &
39 Krueger, 2019), extended emotion (Stephan et al., 2014; Slaby, 2014; Krueger & Szanto, 2016) and
40 affective resonance (Mühlhoff, 2015) have been used to describe similar phenomena occurring at the
41 levels of mother-infant dyads (Krueger, 2014), work teams (Huebner, 2011), organizations (Schmid,

42 2014), sports audiences (Thonhauser & Wetzels, 2019), online communities (Holyst, 2017; Garcia &
43 Rimé, 2019) and nations (Bar-Tal et al., 2007; Sullivan, 2018). Furthermore, accounts of collective
44 emotion differ in their theorizing, insisting upon different emotional components, such as emotional
45 appraisal or subjective feeling, and putting forwards various explanations in terms of bottom-up
46 factors, top-down factors or both (see Pacherie, 2017 for a review). As a result, collective emotion
47 represents a challenge for contemporary affective sciences. Despite the recent surge in research on
48 collective emotion, experimental evaluation of theoretical claims is critically lacking, which continues
49 to hinder progress in the field.

50 Thus, this work aims at uniting the current knowledge concerning collective emotion into a
51 common framework in order to foster experimental investigation. Here, we are not talking about
52 collective emotion to imply that social entities can experience emotions in the same way as
53 individuals: rather, we will leave aside the existing discussions on the nature of group agents and the
54 possibility of group consciousness (Pacherie, 2017; List, 2018) and stick to a consensual view of
55 emotion as primarily involving a set of physiological responses, subjective experiences, expressions
56 and action tendencies at an individual-level¹ (Scherer, 1984). Furthermore, we will restrict the
57 current discussion to acute collective emotional responses occurring in the range of seconds to
58 minutes, as opposed to moods. We thus use collective emotion as an umbrella term describing the
59 alignment of individual emotional responses through mutual and reciprocal influences (von Scheve &
60 Ismer, 2013).

61 In Section 1, we identify three characteristics of collective emotion that are recurrent in the
62 existing literature and emphasize their relation to social and cognitive processes. In Section 2, we
63 build upon these characteristics to provide a typology of collective emotion, ranging from low to high
64 degrees of collectiveness. In Section 3, we review the available empirical evidence regarding

¹ See, for example, Huebner (2011) and Gilbert (2002) for theories of collective emotion that do not necessarily assume similar emotional experiences at an individual-level. These theories formulate accounts in terms of distributed cognition and joint commitment to evaluative judgments, respectively.

65 candidate mechanisms, factors and outcomes of collective emotion, and we outline potential
66 directions for future research.

67 **1. Main characteristics of collective emotion**

68 Despite theoretical divides, we note three recurrent characteristics of collective emotion in
69 the existing literature: emotion alignment, feeling of connectedness and mutual awareness.

70 **1.1. Emotion alignment**

71 The first characteristic of collective emotion is *alignment*, which refers to the “dynamic and
72 reciprocal adjustment of the components of a system for its coordinated functioning” (Dumas &
73 Fairhurst, 2021, p. 3). Assuming that individuals can be viewed as components of collective systems,
74 emotion alignment is characterized in terms of three main properties: convergence, direct coupling
75 and synchrony. First, *convergence* refers to alignment in form and content: individuals emotionally
76 converge when their emotions become increasingly similar over time (Anderson & Keltner, 2004;
77 Dezechache et al., 2016). Two individuals are said to converge when they appraise (i.e., consciously or
78 unconsciously evaluate) a situation similarly (i.e., convergence in evaluative content) and when they
79 exhibit similar facial expressions, manifest similar action tendencies and experience similar feelings
80 (i.e., convergence in emotional response). Second, *direct coupling* assumes that convergence is non-
81 incidental and results from reciprocal entrainment between individuals (i.e., with social interaction),
82 as opposed to merely *indirect coupling* mediated by a common emotion-elicitor (i.e., with attention
83 directed toward the same event). Lastly, *synchrony* refers to the temporal alignment of emotional
84 responses across individuals (Wood et al., 2021), so that the time courses of individual responses
85 predict each other. Note that synchrony may result from indirect coupling, direct coupling or both.
86 Synchrony due to indirect coupling refers to convergent linkage, whereas synchrony due to direct
87 coupling refers to complementary linkage (Elfenbein, 2014) and can be conceptualized as the co-
88 variation of individual emotional responses within an interpersonal system (Butler, 2011). Overall,
89 convergence, direct coupling and synchrony predict several emergent group-level characteristics of

90 emotional responses during collective emotion (Goldenberg et al., 2020): consolidation and
91 synchronization (i.e., decrease in interpersonal variability), up- and down-regulation (i.e., convergent
92 increase or decrease in amplitude) and emotional cascade (i.e., increase in length). What are the
93 processes underlying emotion alignment? We now discuss different categories of mechanistic
94 explanations for emotion alignment: interaction, identification and institutionalization (see also
95 Menges & Kilduff, 2015; Dezechache et al., 2016).

96 *Interaction* refers to the reciprocal influence of individuals during a social interaction. A
97 prominent set of theories accounts for emotion alignment in terms of emotion contagion². According
98 to the Primary Emotion Contagion model (Hatfield et al., 1992), individuals tend to unintentionally
99 and automatically mimic the emotional facial expressions and bodily postures of other individuals,
100 leading them to experience similar emotions through afferent feedback. Moreover, the temporal
101 dynamic between the expresser and the perceiver implies some degree of synchrony and direct
102 coupling between emotional responses. Thus, contagion has been defined as a potential precursor of
103 collective emotion (Hatfield et al., 2014). Another seminal account of emotion alignment argues that
104 it does not result from automatic emotion contagion. Instead, alignment is the by-product of an
105 adaptive perception-action matching system that promotes the implicit representation or simulation
106 of others' actions during social interactions (Preston & de Waal, 2002). Two further mechanisms
107 could also contribute to explaining emotion alignment: social appraisal and orientation calibration
108 (Parkinson, 2019). On the one hand, appraisal theories (Frijda, 1986; Lazarus, 1991a; Scherer et al.,
109 2001) consider that an emotional response results from the appraisal of a situation. Appraisals are
110 permeable to contextual social information, including cues about other individuals and their
111 emotions, hence, one's appraisal of a situation is continuously shaped and revised based on one's
112 own implicit or explicit representation of others' emotional responses (Manstead & Fischer, 2001).
113 This process, called social appraisal, provides an explanation for emotion alignment over time. On the

² Emotion contagion (i.e., a set of mechanistic explanations) is often conflated with emotion alignment. We distinguish both to emphasize the existence of alternative explanations of emotion alignment (e.g., social appraisal, orientation calibration).

114 other hand, orientation calibration refers to the role of interpersonal entrainment mechanisms:
115 during social interactions, individuals spontaneously adjust their gaze direction and bodily
116 movements to those of other people, orienting their attention and behaviour in socially relevant
117 ways (Parkinson, 2019). Unlike social appraisal, the orientation calibration hypothesis proposes that
118 emotion alignment results from low-level bodily synchronization rather than the perception of
119 others' emotions. Typical empirical measures of interaction effects involve the manipulation and
120 recording of interpersonal synchrony at autonomic (Palumbo et al., 2017), cerebral (Nummenmaa et
121 al., 2018) and motoric (Hove & Risen, 2009) levels (see Section 3.3).

122 *Identification* refers to the effect of one's perceived affiliation with another individual or
123 social group (Taipale, 2019). According to the Intergroup Emotion theory (Smith, 1993), individuals
124 who self-categorize as members of a specific social group appraise a situation from this group's
125 stance. Consequently, individuals identifying with the same social group are likely to respond
126 similarly to a group-relevant situation, experiencing similar emotions on behalf of the group: group-
127 based emotions (Mackie & Smith, 2017). According to the Social Identity Theory (Tajfel & Turner,
128 2004), social identification therefore explains emotional convergence within social groups. These
129 emotional responses to group-relevant events do not necessarily involve emotional synchrony or
130 direct coupling between interacting individuals. When remotely located, unacquainted political
131 supporters learn about the election of their leader, they experience *group-based joy*, but the group
132 members may experience these emotions at different points in time and in complete isolation from
133 one another. Such social identification can be manipulated in experimental settings using, for
134 instance, the minimal group paradigm (Tajfel, 1970).

135 *Institutionalization* refers to the influence of emotional norms on emotion alignment.
136 Through socialization, individuals learn the range of appropriate emotions they ought to feel
137 (Hochschild, 1979) and display (Ekman & Friesen, 1969) in a given context. These rules, which are
138 culture-specific, co-exist with ideal affects mirroring individuals' preferences for being in specific
139 affective states (Tsai et al., 2006). When individuals identify with a common social group, they are

140 likely to adopt the same norms and to endorse the group's ideal affect. Crucially, individuals are
141 motivated to comply with and to conform to the group's norms, even without awareness of the
142 effects of social influence (Cialdini & Goldstein, 2004). Discrepancies between one's actual emotion
143 and the emotional norms or ideals can lead to investing resources in emotion work (Hochschild,
144 1979) such as emotion regulation (Gross, 1998) and co-regulation³ (Butler & Randall, 2013), which
145 previous research has argued serves as a basis for collective emotion (Krueger, 2015).

146 To sum up, we distinguish between two main paths to emotion alignment: the interactive
147 path pertaining to perception and representation of other individuals, and the non-interactive path
148 relying on social identification and institutionalization (for a similar distinction, see Klep et al., 2011).
149 However, it is noteworthy that interaction, identification and institutionalization mechanisms
150 interplay as respective factors and moderators (Menges & Kilduff, 2015). For example, self-
151 categorization is dynamic and relies on the saliency of a particular group membership at a given point
152 in time, which can be heavily influenced during social interaction (Stets & Trettevik, 2014; Smith &
153 Mackie, 2015). Conversely, interaction mechanisms such as mimicry-based contagion and
154 perception-action matching are permeable to social identification (Wrobel & Imbir, 2019; Smith &
155 Mackie, 2016b). As an illustration, individuals may socially appraise the emotional expressions of a
156 fellow group member (i.e., group-based social appraisal, see Parkinson, 2019) as cues indicating the
157 relevant emotional norms of that group (Illouz et al., 2014). Consequently, these individuals would
158 engage in specific forms of emotion regulation to conform to these norms, such as interpersonal
159 emotion regulation (Butler & Randall, 2013; Zaki & Williams, 2013) measured as time-lagged
160 physiological covariation between individuals (Helm et al., 2018). Mechanisms pertaining to
161 interaction, identification and institutionalization are the hypothetical bases for emotion alignment
162 during a collective emotion (Pacherie, 2017). However, group-level patterns of emotion alignment

³ Following Butler & Randall (2013), we define emotion co-regulation as direct interpersonal coupling that entails synchronization and convergence of emotional responses towards an optimal level. It is worth noting that co-regulation is a morphostatic process that predicts fluctuations towards a stable emotional state. In contrast, interaction mechanisms such as emotion contagion are morphogenic processes that predict fluctuations towards an altered emotional state (e.g., mutual entrainment resulting in increased emotional arousal).

163 are not the only characteristics put forth in research on collective emotion. Erudition in social
164 sciences and philosophy stresses that collective emotion is a shared experience that involves a
165 specific kind of feeling and awareness of other individuals, although again, terminologies and
166 definitions vary across research traditions.

167 **1.2. Feeling of connectedness**

168 The second characteristic of collective emotion refers to the experiential quality of collective
169 or shared experiences: compared to non-collective emotional experiences, collective emotion *feels*
170 different. In social sciences, this idea draws from the pioneering work of Durkheim (1915) on rituals.
171 The main function of these collective gatherings is to produce and maintain social cohesion through
172 elicitation of *collective effervescence*. In his neo-Durkheimian account of collective emotion, Collins
173 (2014) describes collective effervescence as “the rhythmic entrainment of all participants into a
174 mood that feels stronger than any of them individually, and carries them along as if under a force
175 from outside” (p. 299). This description highlights a few emergent properties of collective emotion at
176 the experiential level: high emotional arousal and low emotional dominance (Russell & Mehrabian,
177 1977), as well as the “feeling of belonging and social integration” (Páez et al., 2015, p. 720) or the
178 “feeling of oneness with the group” defining identity fusion (Swann et al., 2012, p. 441). While social
179 rituals are ubiquitous (Collins, 2014; Whitehouse, 2021) and experiences of collective effervescence
180 frequent in everyday settings (Gabriel et al., 2019), one can distinguish between two types of rituals
181 (Whitehouse & Lanman, 2014; Whitehouse, 2021, pp. 55-58): on the one hand, doctrinal rituals that
182 are high-frequency, large-scale, low-arousal and foster group identification by way of routinized
183 behaviours; on the other hand, imagistic rituals that are low-frequency, small-scale, highly arousing
184 and lead to identity fusion by way of intense shared emotional experiences. Levels of arousal and
185 dominance characterizing an emotional experience can be empirically assessed through self-report
186 scales of emotion, such as the Self-Assessment Manikin (SAM; Bradley & Lang, 1994), whereas other
187 self-report tools measure collective effervescence (Gabriel et al., 2019), perception of emotional
188 synchrony (PES; Włodarczyk et al., 2020), and inclusion of other in the self (IOS; Aron et al., 1992).

189 Accordingly, collective emotion could imply the co-existence of two types of feelings: the feeling
190 elicited as a response to the emotional event (e.g., the group-based joy inspired by the victory of
191 one's political party) and the feeling of connectedness elicited as a response to the sharing of this
192 event (e.g., the feeling of unity resulting from the perception of joy overwhelming all party
193 members).

194 An alternative account of the experiential quality of collective emotion draws from the
195 phenomenological tradition and the concept of "we" experience inspired by Tuomela's (2007)
196 terminology. The core idea is that a collective emotion is felt as *our* emotion rather than *my* emotion,
197 although it is debated as to what exactly is meant by the first-person plural. On the one hand, "we"
198 emotional experience is thought to result from a phenomenal fusion, whereby individuals pre-
199 reflectively⁴ experience their emotion from a first-person plural perspective (Schmid, 2014). This
200 approach bears strong similarities to the aforementioned description of feeling of connectedness in
201 terms of identity fusion: the specific experiential quality of collective emotion derives from self-
202 categorization as a group member leading to a blurring of the distinction between the self and other
203 individuals. On the other hand, "we" emotional experience is thought to result from identification
204 with other specific individuals (León et al., 2017) – as opposed to self-categorization as a group
205 member – and representation of their emotions, while preserving the distinction between the self
206 and these other individuals (Zahavi, 2015; Zahavi & Rochat, 2015). This latter view on emotional
207 sharing differs from the experience of vicarious feelings (i.e., feeling the emotion of others as one's
208 own) and from empathy (i.e., understanding the emotion of others without necessarily feeling it).
209 Furthermore, this account of emotional sharing insists that collective emotion not only relies on a
210 feeling of connectedness but also on reciprocal or mutual awareness between partaking individuals
211 (see Thonhauser, 2018 for an articulation of these two characteristics).

⁴ In this paper, we distinguish between (i) reflective awareness, which supposes explicitly reflecting upon one's own experience, and (ii) pre-reflective awareness, which does not suppose such explicit reflection.

212 **1.3. Mutual awareness**

213 According to Salmela (2012) and Salmela & Nagatsu (2017), individuals involved in a
214 collective emotion are mutually aware of each other and their emotion alignment: (i) individuals are
215 aware that their emotions align, (ii) they know that other individuals are aware of this fact too, and
216 (iii) they know that other individuals know of their awareness of this fact. Alternative accounts
217 contend that collective emotion does not necessarily imply iterative inferences and common
218 knowledge about the emotions of other individuals. Rather, collective emotion entails “mutual
219 awareness of a plurality of partaking individuals” (Thonhauser 2018, p. 1008) or mutual awareness of
220 co-presence (León, 2020). We describe two candidate mechanisms for mutual awareness in the
221 context of collective emotion.

222 First, mutual awareness during collective emotion suggests that partaking individuals engage
223 in joint attention. In paradigmatic examples of collective emotion, such as the emotion of audience
224 members watching a sports game (Thonhauser & Wetzels, 2019) or listening to music (Krueger,
225 2014), individuals exhibit shared or joint attention (Shteynberg, 2018; Siposova & Carpenter, 2019).
226 Previous research suggests that mutual attention, a type of social attention, underlies mutual
227 awareness between two individuals that simultaneously attend to the same event, as well as to each
228 other attending to the event and to the other individual. Siposova & Carpenter (2019) define mutual
229 attention as “individuals being aware – in a second-person relation to each other, but without
230 intentional communication – that they are attending to the same thing with each other” (p. 263).
231 Therefore, social attention, especially mutual attention, provides a mechanistic basis for collective
232 emotion (Pacherie, 2017; Krueger, 2014; Collins, 2014).

233 Second, co-representation of the emotions of other individuals may also foster awareness of
234 the alignment of their emotions with ours. As mentioned before, individuals tend to spontaneously
235 and implicitly represent the behaviours, thoughts and feelings of other individuals in addition to their
236 own (Smith & Mackie, 2016b). This is crucial, for instance, when individuals engage in cooperative
237 joint action, whereby individuals must represent the action plan of their partner as well as their own

238 in order to successfully coordinate (Sebanz et al., 2003). Two characteristics of co-representation are
239 worth stressing: (i) co-representation can be implicit and does not necessarily imply reflective
240 awareness of other's mental states and (ii) successful co-representation entails, to some extent,
241 distinguishing between the self and other individuals, so that individuals do not mistake others'
242 representations for their own. Therefore, individuals who are representing their own emotion and
243 those of other individuals (i) need not be reflectively aware of these emotions and (ii) need not feel
244 the emotion of the co-represented individual. *Implicit* co-representation is usually measured through
245 social interference effects, such as the Social Simon Effect (Sebanz et al., 2003), which vary according
246 to the affective context (Beaurenaut et al., 2021). However, co-representation can also lead to
247 *explicit* inferences of the mental states of other individuals. When it does, successful co-
248 representation is assessed as inferential accuracy: for instance, empathic accuracy (Ickes, 2009;
249 2016) measures the ability to infer the thoughts and feelings of another individual, and emotional
250 aperture (Sanchez-Burks & Huy, 2009) measures the ability to infer the emotional composition of a
251 group (see Section 3.4).

252 Therefore, we can describe mutual awareness during collective emotion as the result of
253 mutual attention that enables successful emotion co-representation. However, when individuals do
254 not engage in mutual attention (e.g., when they do not have perceptual access to each other), they
255 may instead simulate the emotions of others based on the belief that one's experience is shared
256 (Smith & Mackie, 2016b). In such contexts, where information about other individuals is lacking,
257 mutual awareness of emotion alignment during a collective emotion could rely on the combination
258 of social projection and self-stereotyping (Cho & Knowles, 2013): the former refers to attributing
259 mental states that are similar to one's own to other individuals, whereas the latter refers to adopting
260 mental states that are congruent with one's beliefs about the group one identifies with.

261 In the first section, we reviewed the literature on collective emotion to identify its main
262 characteristics and the corresponding candidate social and cognitive mechanisms. Emotion alignment
263 refers to group-level patterns of emotional responses at the behavioral, experiential, cerebral and

264 autonomic levels; feeling of connectedness and mutual awareness refer to the experiential quality of
265 collective emotion, which involves changes in the representation of other individuals and the self,
266 either reflectively or not. Summing up, current knowledge predicts several measurable
267 characteristics of collective emotion: first, consolidation, synchronization, amplitude regulation and
268 cascades of emotional responses; second, subjective feelings of rapport and social integration; third,
269 joint attention and co-representation of emotional states that can lead to explicit and mutual
270 knowledge. Although these characteristics are conceptually independent, we highlighted their
271 potential interplay during collective emotion. Nonetheless, temporal and causal relations between
272 these characteristics and the existence of common modulators remain to be investigated
273 experimentally.

274 **2. Typology of collective emotion**

275 As mentioned in the introduction, a striking aspect of the literature concerning collective
276 emotion is the diversity of examples and definitions of this phenomenon. Yet, we argue that
277 collective emotion is a broad construct and that heterogeneity sometimes reflects differences in
278 degrees of collectiveness rather than theoretical incompatibility.

279 ***2.1. Salmela's typology***

280 Salmela (2012) argued that the collectiveness of an emotion varies along a continuum and
281 distinguished three types of collective emotion: weakly, moderately and strongly shared emotions.
282 This typology builds on a definition of emotions in terms of concerns (i.e., goals, interests,
283 attachments). Consequently, the collectiveness of an emotion depends on the mode under which
284 individuals share concerns with one another. According to Salmela, the weakest degree of collective
285 emotion corresponds to overlapping concerns with private commitments, such as the fear of private
286 brokers anticipating a stock crash. The brokers share a common overlapping aversion for decreasing
287 stock value, and their attachment to stock value is private, insofar as they care about stock value for

288 their own personal reasons, independently from other brokers. In comparison, moderately collective
289 emotions correspond to social concerns with private commitment, such as the joy of supporters
290 when their favourite team scores. Here, the supporters' concern is social, insofar as the team's
291 victory benefits the group of supporters as a whole and there is mutual knowledge that supporters
292 care about victory. Nonetheless, commitments remain private, as individuals can revise their
293 commitment (i.e., they can stop supporting the team) unilaterally without affecting others. Lastly,
294 strongly collective emotions correspond to social concerns with collective commitment. Unlike the
295 supporters' joy, the joy of the team members playing the game is strongly collective, in that their
296 commitment to victory is collective, hence, their individually experiencing joy depends on other team
297 members experiencing joy, too. In summary, the more social the concern and the commitment, the
298 more collective the emotion.

299 Salmela (2012) stressed that modes of sharing concerns prevail in determining the degree of
300 collectiveness of an emotion. This proposal is insightful, because human groups differ in their degree
301 of collectiveness (i.e., overlap of concerns, strength of commitment) to begin with, and because this
302 degree of collectiveness is contextual. However, by Salmela's own admission, this typology only
303 accounts for the "intentional background" (Salmela, 2014, p. 171) of collective emotion, namely the
304 set of beliefs, values and commitments pre-existing to experiencing collective emotion. Therefore, a
305 typology based on shared concerns insists on the specific antecedents of collective emotion, such as
306 group membership, but ignores the emotional dynamics unfolding *during* the collective emotional
307 event. More recently, Thonhauser (2022) distinguished between five types of collective emotion,
308 convincingly insisting on differences in affective experiences but intentionally dismissing a
309 classification in terms of underlying mechanisms. We believe a closer examination of the underlying
310 mechanisms of collective emotion is necessary if we are to provide a relevant framework for
311 empirical research⁵.

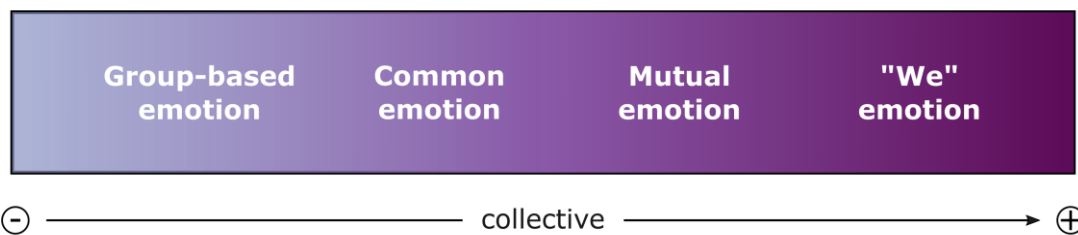
⁵ Although our definition of collective emotion is broader than Thonhauser's, our characterizations of the phenomenon show similarities. However, we believe Thonhauser's primary focus on affective experiences is too restrictive. It is now a consensual view that emotions are multi-componential phenomena that extend

312 **2.2. A new typology of collective emotion**

313 To address this gap, we propose a complementary account of emotional collectiveness based
314 on the categories of social and cognitive processes that we identified in Section 1: emotion
315 alignment, mutual awareness and feeling of connectedness. This proposal draws on recent
316 typologies of social attention (Siposova & Carpenter, 2019) and social agency (Silver et al., 2021)
317 based on their dynamic characteristics. Here, the type of collective emotion depends on the
318 categories of social and cognitive processes involved and the extent to which they occur. We define
319 four types of collective emotion: group-based, common, mutual and “we” collective emotions,
320 ranging from low to high degrees of collectiveness. Figure 2 represents this continuous scale, with
321 grading colours indicating that there is no sharp separation between contiguous types of collective
322 emotion. We stress that this scale does not reflect an exhaustive categorization of group emotions,
323 as other group-level patterns can emerge involving divergent emotions within the group (e.g.,
324 complementary, antagonistic). Moreover, this scale does not reflect the temporal unfolding of a
325 collective emotion, although lesser degrees of collective emotion are sometimes prerequisites for
326 higher degrees of collective emotion. Lastly, we restrict this typology to non-incidental cases of
327 collective emotion, so that a minimal prerequisite is that individuals attend and respond to the same
328 emotion-eliciting event. In the following paragraphs, we present the four types of collective
329 emotions, indicate their relation to existing theories and provide examples.

330

beyond the realm of subjective experiences. Thus, exclusively focusing on affective experience comes with the risk of overlooking implicit aspects of emotion that can warrant other relevant distinctions. We share Thonhauser’s objective to provide a relevant framework for future empirical research, but this endeavour requires accounting for the broad range of implicit affective processes involved in emotion and human social cognition.

331 **Figure 1**332 *Scale of collective emotion*

333

334 *Note.* The four types of collective emotion distributed along a continuum of collectiveness. Gradient
 335 colors illustrate that there is no sharp boundary between types of collective emotion.

336

337 *Group-based emotion.* The weakest degree of collective emotion in our typology relates to
 338 non-interactive emotion alignment between members of a social group attending to the same group-
 339 relevant event. As mentioned before, group-based emotion occurs when individuals appraise an
 340 event similarly from the group's stance, without *necessarily*⁶ interacting with each other. In other
 341 words, group-based emotion involves emotional convergence between individuals bound by their
 342 social identity. As such, group-based emotion is collective in a weak, attributive sense, because
 343 partaking individuals form an abstract collective, without direct and reciprocal influence between
 344 them. For example, think of the joy of French TV viewers watching France's football team score
 345 against Croatia during the 2018 FIFA World Cup final. Because this sporting event involves a
 346 competition between two national teams, French TV viewers are likely to identify with their nation,
 347 leading them to appraise the game's events from a common group stance despite interpersonal
 348 differences. Consequently, French TV viewers, at that particular moment, show convergent and
 349 synchronous emotional responses, jumping and screaming with exultation. Note that this notion of
 350 collectiveness is closely related to Salmela's definition in terms of shared concerns (Salmela, 2014):
 351 French TV viewers share a moderately collective emotion. Here, however, we are interested in

⁶ Group-based emotion theory does not preclude either interacting with other individuals, or thinking about other individuals and how they feel. However, we stress that social interaction and awareness of other individuals and their emotions are not constitutive of this type of collective emotion.

352 characterizing the emotional dynamics within the group *during* the event: the group-based joy of
353 French TV viewers allegedly relies on self-categorization (i.e., as French or French supporters),
354 institutionalized norms (i.e., the specific unfolding of a football game) and entrainment to a common
355 emotion elicitor (i.e., the French team scoring), but it does not rely on social interaction⁷. To sum up,
356 the emotional responses of French TV viewers parallel each other, without involving any proper
357 interpersonal dynamics within the group.

358 *Common emotion.* As compared to group-based emotion, common emotion relies on
359 interactive emotion alignment with direct reciprocal coupling between individuals. Because partaking
360 individuals stand within perceptual reach, they reciprocally influence each other, even unconsciously,
361 through verbal and non-verbal cues. Therefore, unlike group-based emotion, the collective in a
362 common emotion is not a social entity composed of abstract, remote individuals, but a specific set of
363 individuals interacting with each other⁸. This difference in social settings relates to heightened social
364 presence (Cui et al., 2013) and social influence via emotion contagion, social appraisal and
365 orientation calibration. As mentioned before, such interaction mechanisms in turn predict group-
366 level properties, such as amplitude regulation and cascades of emotional responses within the group.
367 For example, consider this time a group of joyful French supporters attending the final at Loujniki
368 stadium, or watching the game on TV together, so that they can hear each other's screams and see
369 each other's smiles when the French team scores. In this example, partaking individuals are exposed
370 to perceptual cues about emotional responses that constitute the group's emotional climate (de
371 Rivera, 1992). Accordingly, the joy of the French supporters does not only reflect their emotional
372 response to the game's events but also to each other's exultation, with the joy of other supporters

⁷ Hypothetically, individuals could be watching the game in complete isolation from one another. In reality, French TV viewers are not isolated from the world – broadcasting of sporting events actually provides viewers with on-going live feedback about the emotional response of the physical audience, such as close-ups on the faces of fellow supporters. Thus, our example represents a dynamic case of group-based emotion: individuals are coupled with a live physical audience, but this coupling is not reciprocal.

⁸ This difference is analogous to the distinction between two levels of analysis in collective emotion research: social groups and network clusters (van der Löwe & Parkinson, 2014). Group-based emotion involves members of social groups (i.e., categories of individuals with similar attributes), whereas common emotion involves clusters of interacting individuals (i.e., defined on the basis of actual relationships).

373 contributing to the shaping of their own joy in implicit and explicit ways. As a result of this mutually
374 reinforcing feedback loop, these supporters are more aroused and their experience more intense and
375 long-lasting than if they had watched the game alone. Compared to the group-based joy of lone
376 French TV viewers, the common joy of the supporters jointly watching the game is properly
377 collective, in that the pattern of joyful responses at the group-level emerges from their
378 interdependency. This case illustrates that there is no sharp distinction between group-based and
379 common collective emotions, as common emotion sometimes builds upon group-based appraisal.
380 However, tokens of common emotion are not necessarily tokens of group-based emotion. For
381 instance, the anger of commuters waiting for a late train is common to the group, and therefore
382 collective, insofar as their emotional responses build up from each other: commuters fulminating,
383 foot tapping and frowning convey their emotion so that they may individually become angrier for
384 longer than had they been waiting for the late train alone. Nonetheless, this group-level pattern
385 reflects private overlapping concerns (Salmela, 2012) and does not involve group-based appraisal.
386 Lastly, note that individuals partaking in a common collective emotion may become reflectively
387 aware of the emotion of other partaking individuals, thus, also involving reciprocal awareness of
388 emotions in the group. However, this knowledge of the emotion of other individuals is not yet
389 mutual, as partaking individuals need not be aware that others know of their emotion.

390 *Mutual emotion.* In comparison, individuals partaking in a mutual collective emotion are
391 mutually aware that their emotion aligns with those of others: they know that their emotional
392 responses synchronously converge in response to the same emotion-eliciting event and know that
393 other individuals are aware of this fact too. As mentioned in Section 1, gaining such a mutual
394 knowledge implies mutual attention, which in turn relies on direct reciprocal contact between
395 partaking individuals. To illustrate this point, imagine two French supporters standing next to each
396 other during the 2018 FIFA World Cup final. When the French team scores, their eyes meet and they
397 instinctively grab each other's arms; in doing so, the two supporters acknowledge that they are
398 feeling the same emotion at that specific moment. In other words, they become aware of the

399 collectiveness of their emotional experience, which marks the difference with lesser degrees of
400 collective emotion. In addition, mutual awareness predicts prosocial behaviours and attitudes.
401 Indeed, partaking individuals may engage in intentional communication about their collective
402 emotion due to a motivation to establish a shared reality (Echterhoff et al., 2009). For example, the
403 two French supporters could verbally communicate their feelings to each other and other supporters
404 (i.e., social sharing of emotions, see Rimé, 2009), further enhancing consolidation, synchronization,
405 amplitude regulation and cascades of emotional responses within the group. Further, mutual
406 knowledge of emotion alignment may demonstrate common group membership, fostering
407 interpersonal attraction and liking between partaking individuals. Note that mutual collective
408 emotion is not bound to dyadic interaction and can arise in larger groups of individuals: partaking
409 individuals could gain mutual knowledge about emotion alignment within a limited subset of
410 individuals, while inferring that they also align with the rest of the group based on its emotional
411 climate or the salience of common group membership.

412 *“We” emotion.* The highest degree of collective emotion in our typology refers to the
413 emergence of a specific feeling of connectedness arising from emotion alignment and mutual
414 awareness thereof. In “we” emotion, partaking individuals shift from a singular to a plural first-
415 person emotional experience. Partaking individuals not only feel the same, they feel as one,
416 reflecting the emergence of a shared collective identity (Reicher & Drury, 2010). Note that this
417 process differs from group identification occurring in lesser degrees of collective emotion. As argued
418 by Neville and Reicher (2011), shared identity is distinct from social identity resulting from self-
419 categorization: individuals share a collective identity as members of a common *embodied* group (i.e.,
420 the group of French or French supporters under mutual and reciprocal influences), and this shared
421 identity is the basis of further prosocial attitudes and behaviours. Firstly, “we” collective emotion
422 predicts implicit or explicit commitments of partaking individuals to further express emotions that
423 are congruent with their shared identity (see Gilbert, 2002 for a discussion of collective emotions in
424 terms of such commitments), again enhancing consolidation, synchronization, amplitude regulation

425 and cascades of emotional responses within the group. Secondly, “we” collective emotion predicts
426 the reinforcement of social cohesion within the group: compliance to the group’s norms, production
427 of symbols and solidarity (Rosner & Meher, 2014; Collins, 2014). Last but not least, “we” collective
428 emotion provides the group of partaking individuals with reasons for collective action and facilitates
429 joint action (Salmela & Nagatsu, 2016). This consequence of “we” collective emotion is obvious in
430 social movements (e.g., Van Ness & Summers-Effler, 2018), where shared identity refers to changes
431 in both intragroup and intergroup relationships motivating collective action (Neville & Reicher, 2011).
432 Returning to the victory of France at the 2018 FIFA World Cup final, French supporters who
433 experience a “we” emotion typically embrace each other, and verbally express their collective
434 identity (e.g., “We did it, we won!”). They also cooperate to act as one, parading together in the
435 streets, chanting and dancing in rhythm and carrying their champions in the air. The positive
436 collective emotion of the supporters may also support the emergence of more complex sentiments,
437 such as national pride. In other words, “we” emotion contributes to reinforcing collective identity
438 and vice versa, hence, forming a positive feedback loop.
439

440 **Table 1**441 *Characteristics of different types of collective emotion*

Main characteristic	Group-based emotion	Common emotion	Mutual emotion	“We” emotion
Non-interactive emotion alignment	*	-	*	*
Interactive emotion alignment	-	*	*	*
Mutual awareness	-	-	*	*
Feeling of connectedness	-	-	-	*

442 *Note.* * indicates that the characteristic is necessary for this type of collective emotion.

443

444 In summary, we distinguished between four types of collective emotions, from low to high
 445 degrees of collectiveness, based on the categories of social and cognitive processes involved (see
 446 Table 1). Group-based collective emotion refers essentially to non-interactive emotion alignment via
 447 group identification; common collective emotion refers to interactive emotion alignment through
 448 implicit or explicit social influence; mutual collective emotion involves mutual co-representation of
 449 emotion or awareness of the collective nature of the emotional episode; “we” emotion refers to the
 450 experience of social connectedness with the emergence of a collective identity.

451 Our typology based on social and cognitive processes complements Salmela’s typology based
 452 on shared concerns (Salmela, 2012): an emotion can be weakly collective in terms of shared concerns
 453 and, inversely, strongly collective in terms of social and cognitive processes . To give but one
 454 example, the fear of private brokers during a market crash is weakly collective (i.e., it involves private
 455 overlapping concerns), but it refers to a wide range of situations and degrees of collectiveness when
 456 considering the unfolding of social and cognitive processes. Brokers can experience common

479 of connectedness and mutual awareness. This review aims at providing an overview of a range of
480 relevant research fields for the study of collective emotion but does not claim to be exhaustive.
481 Research on social presence and shared experience (Sub-section 3.1), emotional convergence (Sub-
482 section 3.2) and interpersonal synchrony (Sub-section 3.3) sheds light on emotion alignment;
483 research on empathic accuracy (Sub-section 3.4) and emotional aperture (Sub-section 3.5)
484 investigates explicit awareness of emotion; research on collective effervescence and self-other
485 blurring (Sub-section 3.6) provides information about the feeling of social connectedness.

486 **3.1. Social presence and shared experience**

487 Research on social presence and shared experience sheds light on the emergence of some of
488 the group-level emotional patterns that define collective emotion (Section 1). Emotions are
489 sometimes considered purely social phenomena that reflect influences from the social context
490 (Parkinson, 1996; Greenaway et al., 2018; Fischer et al., 2003), including the presence of other
491 individuals. Indeed, the felt presence of other individuals, or social presence (Cui et al., 2013),
492 amplifies our subjective experience (Boothby et al., 2014): participants playing a game reported
493 experiencing more fun (Reis et al., 2017), and participants facing a stressful test reported
494 experiencing more stress (Nahleen et al., 2019) when they were undergoing the task together with
495 another individual. Crucially, merely believing that other individuals are physically co-located and co-
496 attending (i.e., simultaneously attending to the same event) modulates emotional responses, even in
497 the absence of a social interaction. In a seminal electromyography study, Fridlund (1991) observed
498 enhanced smiling activity when participants watched pleasant videos with a friend, or when believing
499 that a friend was simultaneously watching the same videos in an adjacent room, as compared to
500 explicit solitary viewing. Subsequent studies found that the effects of co-attention on emotions are
501 not restricted to their communicative function. For example, Jakobs and colleagues (1996) showed
502 that imagining experiencing an emotion in public or private contexts prompted higher self-reported
503 happiness and anger in public contexts and higher self-reported fear and sadness in private contexts.

504 In sum, amplification of emotional experiences due to social presence does not necessarily imply that
505 the experience is actually shared.

506 What are the cognitive processes underlying the effects of social presence on subjective
507 experience? On the one hand, amplification of subjective evaluations during shared experiences
508 positively correlated with increased mentalizing, indexed by self-reported thinking about the
509 thoughts and feelings of other individuals (Boothby et al., 2014; Nahleen et al., 2019). On the other
510 hand, amplification positively related to increased allocation of attention and increased processing of
511 stimuli (Shteynberg et al., 2014). A recent electroencephalogram (EEG) study supports this argument
512 demonstrating increased allocation of attention to emotional facial expressions when these
513 expressions were perceived with other individuals versus alone, regardless of emotional valence
514 (Schiano Lomorello et al., 2020). Overall, previous research suggests that amplification effects
515 significantly depend on the psychological or social distance between participants (Boothby et al.,
516 2016). In particular, studies found significantly larger effects for natural groups of friends than for
517 unacquainted individuals (Reis et al., 2017) and minimal groups (Shteynberg, 2018), and amplification
518 increased with perceived similarity (Shteynberg, 2010).

519 Furthermore, the effects of social presence are not limited to amplifying shared emotional
520 experiences: the presence of other individuals can also buffer negative experiences (Beaurenaut et
521 al., 2021; Kikusui et al., 2006; Tedeschi et al., 2021). Valence ratings of negative and positive
522 emotional pictures were less negative when participants were told that a friend was co-attending to
523 the same picture compared to a different one (Wagner et al., 2015). A subsequent study found that
524 this effect was related to increased activity in the reward circuitry (i.e., ventral striatum and medial
525 orbitofrontal cortex), congruent with the observation that shared experiences are more enjoyable,
526 even when they involve being frightened (Andersen et al., 2020).

527 In short, previous research supported the idea that shared experiences, including emotional
528 experiences, are socially regulated and that perceived social distance between individuals modulates
529 these effects. In particular, social presence and (perceived) co-attention contribute to the emergence

530 of group-level patterns pertaining to up- and down-regulation of emotional responses (i.e.,
531 amplification or buffering). These effects are observed even in contexts devoid of reciprocal social
532 interaction, which characterize some episodes of group-based collective emotion. Lastly, shared
533 emotional experiences predict some of the defining features of social relationships: for instance,
534 shared experiences of positive affect between spouses discussing together predicted their marital
535 quality (Brown et al., 2021).

536 **3.2. Emotional convergence**

537 Another characteristic of collective emotion is emotional convergence, defined as a decrease
538 in interpersonal variability of emotional responses (Sub-section 1.1). The literature on collective
539 emotion suggests that individuals emotionally converge in various social settings as a result of
540 different mechanisms pertaining to social identification and social interaction (see Section 1.1).

541 To begin with identification mechanisms, group-based appraisal (i.e., appraisal of a situation
542 based on social identity) explains emotional convergence independently of social interaction.
543 Previous research confirmed that the emotions of individuals primed with a similar social identity
544 tended to converge towards explicit stereotypical emotions, and that this convergence positively
545 correlated with the strength of their social identification (Seger et al., 2009). Moreover, researchers
546 found evidence for a bidirectional relationship between group identification and emotional
547 convergence: self-categorization as a group member positively predicted emotional convergence and
548 convergence positively predicted group identification (Delvaux, 2015), even in the case of artificially-
549 induced group membership (Livingstone et al., 2011).

550 Regarding interaction mechanisms, previous research indicates that emotional convergence
551 occurs when individuals who experienced an emotion verbally communicated their feelings to other
552 individuals. Emotional convergence due to social sharing of emotion (Rimé, 2009) has been observed
553 in laboratory settings during face-to-face interaction (e.g., Zheng et al., 2020) and text-based
554 discussion, even when the emotion of the individuals sharing their experience is opaque to the
555 receivers (Guillory et al., 2011). Crucially, emotional convergence within groups of three participants

556 had effects on the group's performances only when convergence involved interaction (i.e., social
557 sharing of emotion, group task) (Klep et al., 2011), which further motivates the distinction between
558 non-interactive group-based emotion and higher degrees of collective emotion. Furthermore,
559 individuals also emotionally converge due to the implicit processing of non-verbal cues. As an
560 example, Dezechache and collaborators (2013) revealed that convergence between individuals does
561 not require intentional communication. Recorded displays of joy and fear elicited congruent
562 electrodermal and facial muscle activity in participants who never saw these emotional displays, but
563 instead only watched another participant responding to them, and even when the emotion of the
564 mediating participant could not be explicitly recognized. These results suggest that emotional
565 convergence relies on the spontaneous and implicit facial mimicry of emotional expressions¹⁰.

566 Previous research also suggests that emotional convergence results from the combination of
567 identification and interaction mechanisms. For example, participants spontaneously mimicked
568 happiness displays of other individuals, yet mimicked sadness displays only when the expresser was a
569 fellow group member (Bourgeois & Hess, 2008)¹¹. In other words, mimicry and appraisal of emotional
570 facial expressions preferentially occurs when common group membership is salient to individuals. In
571 addition, comparison between dyads of friends and strangers simultaneously watching emotional
572 film clips together revealed that friends converged in self-reported emotion to a greater extent than
573 strangers, and that convergence between self-reported emotions was higher for amusing films when
574 participants could see each other than when they could not (Bruder et al., 2012). Notably, the effects
575 of social identification on emotional convergence during minimalistic social interaction (i.e., direct
576 observation or co-attention) is not limited to positive emotional contexts. Participants exhibited
577 higher levels of cortisol when observing another individual undergoing a stressful test after

¹⁰ Facial mimicry is the focus of divergent theoretical frameworks, including the facial feedback hypothesis, the social context theory and the perception action model (for an overview and a meta-analysis, see Holland et al., 2020).

¹¹ These findings have been discussed as evidence that mimicry-based emotional convergence relies on contextual interpretation of the expresser's emotional expression, similar to social appraisal rather than automatic contagion (Parkinson, 2019; Fischer & Hess, 2017).

578 experimental induction of common group identification as compared with a control group, although
579 subjective levels of stress did not differ (Schury et al., 2020). Overall, these findings are in line with
580 longitudinal studies of affective convergence occurring in natural social networks (e.g., Fowler &
581 Christakis, 2008), such as work teams¹² (e.g., Tanghe et al., 2010; Delvaux et al., 2015) and online
582 communities (Garcia & Rimé, 2019; for a review, see Goldenberg & Gross, 2020).

583 In short, previous research demonstrates that emotional convergence assessed at the
584 behavioural, autonomic and hormonal levels is contextual (i.e., it depends on social identification and
585 emotional valence) and sometimes implicit (i.e., individuals need not be reflexively aware of the
586 emotion of the other individuals). Further, available empirical evidence supports the hypothesis that
587 emotional convergence can result from the combination of identification and interaction
588 mechanisms, which is congruent with our description of common, mutual and “we” collective
589 emotions. Psychological research on emotional convergence has been at the core of agent-based
590 models of collective emotion (e.g., Garcia et al., 2017) exploring the temporal dynamics of emotion
591 alignment, including the synchronicity of emotional responses.

592 **3.3. Interpersonal synchrony**

593 Interpersonal synchrony arises either independently from social interaction (i.e., externally-
594 driven synchrony), or due to direct coupling between individuals (Nummenmaa et al., 2018). Here,
595 we review empirical evidence regarding the latter type of synchrony occurring at the behavioural,
596 autonomic and cerebral levels.

597 *Behavioural synchrony* is a prominent feature of collective emotional gatherings (Knottnerus,
598 2015). Extensive research has identified the positive individual and social outcomes of synchronicity
599 in movements and vocalizations (see Rennung & Göritz, 2016 and Mogan et al., 2017 for meta-

¹² Notably, work teams converged despite role asymmetries between team leaders and other team members. Tanghe and colleagues (2010) mention two possible explanations: individuals strongly identifying with the group, such as team leaders, could either influence fellow group members to a greater extent, or conversely adjust their own affect given the self-relevance of emotional cues within the group. These hypotheses underscore how emotion convergence can be directional within groups of individuals characterized by unequal distribution of social influence.

600 analyses of these effects), such as elevated pain threshold (Cohen et al., 2010; Tarr et al., 2015),
601 positive affect (Tschacher et al., 2014), cooperation (Wiltermuth & Heath, 2009) and affiliation (Hove
602 & Risen, 2009). Empirical evidence also indicates that synchronicity in facial expressions of emotion
603 occurs spontaneously and relates to positive social outcomes. For instance, temporal alignment and
604 congruency of facial emotion expressions during co-viewing of a TV show positively predicted self-
605 reported social connection between co-viewers (Cheong et al., 2020). Similarly, temporally aligned
606 laughter in response to affective stimuli predicted relationship satisfaction (Kurtz & Algoe, 2017).

607 What are the cognitive mechanisms underlying the prosocial effects of behavioural
608 synchrony? In their meta-analysis, Mogan and colleagues (2017) showed that the effects of
609 behavioural synchrony varied with the size of the group: group size positively predicted prosocial
610 behaviour and positive affect, but not social cognition and perceived social bonding. These results
611 were interpreted as evidence supporting a distinction between different mechanisms: in small
612 groups, behavioural synchrony would signal to synchronized individuals that they share goals and
613 promote social attention; in large groups, behavioural synchrony would foster collective
614 effervescence including increases in bodily and emotional arousal. A recent experimental study
615 manipulating motoric synchrony and bodily arousal in large groups (i.e., 40-50 participants) found
616 evidence that cohesion and cooperation increased when motoric synchronicity was paired with 'high'
617 bodily arousal (Jackson et al., 2021).

618 *Autonomic synchrony* is the interpersonal co-variation in the activity of the parasympathetic
619 and sympathetic nervous systems regulating, among others, respiration and heartbeat (see Palumbo
620 et al., 2017 for a review). A recent meta-analysis revealed that autonomic synchrony is positively but
621 weakly related to positive relationship outcomes and group performance (Mayo et al., 2021). For
622 instance, autonomic synchrony predicted marital satisfaction between spouses (Levenson &
623 Gottman, 1983; Chen et al., 2020), as well as affiliation, attraction (e.g., Golland et al., 2019;
624 Prochazkova et al., 2021), or cooperation (Behrens et al., 2020) between strangers. Crucially for
625 research on collective emotion, autonomic synchrony also reflects emotion alignment: similarity in

626 self-reported emotion positively correlated with cardiac synchrony between unacquainted spectators
627 attending a theatrical performance (Ardizzi et al., 2020) and with electrodermal, cardiac and
628 zygomatic synchrony in watching emotional film clips (Golland et al., 2015; 2019). Thus, autonomic
629 synchrony sometimes reflects alignment in emotional experiences that positively predicts affiliation
630 (Golland et al., 2019). These experimental results are congruent with the hypothesis that
631 interpersonal autonomic synchrony is a biological correlate of collective emotion, although further
632 research is needed to specify the causal relation between these phenomena.

633 Controlled experimental studies found that autonomic synchrony varied according to the
634 emotion elicited in participants and their pre-existing relation (e.g., Bizzego et al., 2019). However,
635 evidence regarding the influence of the relationship between participants is mixed. On the one hand,
636 greater cardiac synchrony was observed between strangers than between friends and lovers (Bizzego
637 et al., 2019), and between participants primed with dissimilarity rather than similarity (Danyluck &
638 Page-Gould, 2018). On the other hand, a physiological study of a fire-walking ritual detected
639 significant levels of cardiac synchrony between fire-walkers and audience members (i.e., in the
640 absence of behavioural coordination), but only when performers and spectators were related family
641 members, implying that autonomic synchrony is related to empathy driven by kinship (Konvalinka et
642 al., 2011). These discrepant results highlight the importance of additional considerations concerning
643 communication modality (e.g., verbal vs. non-verbal), autonomic channels (e.g., sympathetic vs.
644 parasympathetic) and type of synchrony (e.g., in-phase vs. anti-phase) in order to interpret
645 autonomic synchrony (Danyluck & Page-Gould, 2019).

646 *Cerebral synchrony* is the topic of a bustling field of research underscoring its role in social
647 coordination, cohesion and group performance (Shamay-Tsoory et al., 2019; Dikker et al., 2021;
648 Reinero et al., 2021). For example, previous research using hyperscanning EEG demonstrated that
649 interbrain synchrony (IBS) is positively related to motor coordination and empathy in different neural
650 regions (Djalovski et al., 2021). In addition, levels of cerebral synchrony varied with social distance
651 between interacting partners (Djalovski et al., 2021; Kinreich et al., 2017), suggesting that cerebral

652 synchrony reflects social connectedness. Indeed, available empirical evidence indicates that cerebral
653 synchrony positively relates to explicit representation of other individuals: perceived self-other
654 overlap and cerebral synchrony in the right dorsolateral prefrontal cortex positively mediated the
655 prosocial effects of dyadic motoric synchrony (Feng et al., 2020). In addition, cerebral synchrony
656 positively correlated with accuracy in inferring pain (Goldstein et al., 2018) and with convergence in
657 self-reported emotion when the partner's emotion was accurately recognized (Anders et al., 2020).
658 These findings suggest that interpersonal cerebral synchrony is a biological correlate of the accurate
659 and explicit representation of other's emotions, or empathic accuracy (see Section 3.4).

660 Overall, previous research on interpersonal synchrony highlights its positive effects on
661 prosocial attitudes and behaviours and demonstrates its variability according to social and affective
662 contexts (i.e., level of arousal, social distance). For these reasons, we do not expect interpersonal
663 synchrony to characterize specific types of collective emotion, but predict that it will increase with
664 the degree of collectiveness as a function of reciprocal social influence. Moreover, the scientific
665 literature suggests that interpersonal synchrony relates to other candidate processes of collective
666 emotion, such as empathic accuracy and collective effervescence.

667 **3.4. Empathic accuracy**

668 Empathic accuracy is the ability to accurately identify the thoughts and feelings of other
669 individuals (Ickes, 2009; 2016)¹³. Research on empathic accuracy investigates what we have been
670 referring to as awareness of others' emotions (Sub-section 1.3). Different factors modulate empathic
671 accuracy: communication modality, emotional valence, traits of the perceiver, expressivity of the
672 target, and the perceiver-target relation. Firstly, previous studies contrasted conditions including
673 visual information only, auditory information only, auditory and verbal information or a combination

¹³ Experimental studies of empathic accuracy mainly relied on the dyadic interaction paradigm (Ickes et al., 1990), in which participants interact with each other and then later watch a video recording of their interaction to report their own feelings and infer those of their interaction partner. Independent judges then compare actual and inferred feelings to yield an accuracy score ranging from 0 to 100. Another experimental paradigm dissociates perceiver and target, so that participants infer the thoughts and feelings of other target participants.

674 of these. A consensus emerged, indicating that verbal cues contributed most to accuracy, followed by
675 paralinguistic cues, with visual non-verbal cues contributing the least (Gesn & Ickes, 1999; Hall &
676 Mast, 2007; Jospe et al., 2020). Regarding emotional valence, previous research revealed that
677 accuracy was greater for recognition of positive compared to negative emotions (Campos et al.,
678 2020). As for the traits of the perceiver, gender differences in empathic accuracy reflect gender-
679 based differences in motivation and conformism to social roles rather than differences in empathic
680 abilities (Ickes, 2016; Laurent & Hodge, 2009). Furthermore, accuracy in emotion recognition related
681 to the perceiver's self-reported tendency for perspective-taking (Israelashvili et al., 2019), as well as
682 self-reported affective empathy when targets were expressive (Zaki et al., 2008). Indeed, the
683 expressivity of the target – and in particular the production of verbal cues – was found to predict
684 empathic accuracy to a greater extent than the perceiver's motivation or ability (Ickes, 2016). In
685 addition, empathic accuracy decreased with social distance between the perceiver and the target:
686 “strangers infer each other's actual (non-randomly paired) thoughts and feelings with an average
687 accuracy score of about 20%; close friends make these inferences with an average accuracy score of
688 about 30%; and married couples achieve average accuracy scores that usually range no higher than
689 35%” (Ickes, 2016; p. 55). Further evidence suggests that social distance biases the inference of
690 thoughts and feelings: accuracy and speed in emotion recognition increased with social and cultural
691 proximity between perceiver and target (Elfenbein & Ambady, 2002 – but see Soto & Levenson,
692 2009). Other studies found a relation between this in-group advantage and increased exposure to in-
693 group members (Elfenbein, 2006), as well as the perceiver's self-reported attentional focus and
694 physical attraction to an opposite-sex target (Ickes et al., 1990). The latter finding supports the
695 hypothesis that the relation between perceiver and target modulates empathic accuracy through
696 attentional and motivational processes.

697 What are the other processes underlying empathic accuracy? On the one hand, previous
698 research suggests that empathic accuracy relies, to some extent, on interpersonal emotional
699 alignment between perceiver and target. Indeed, perceivers, whose ability to produce facial

700 expressions was impaired with a gel facemask, showed lower accuracy in emotion recognition of
701 targets' facial expressions (Wood et al., 2016). A study involving Transcranial Magnetic Stimulation
702 (TMS) found similar evidence: accuracy in discriminating fake from real smiles decreased with
703 disruptive stimulation of sensorimotor brain areas (underlying the perception and simulation of
704 other's movements), but not with disruptive stimulation of brain areas involved in mentalizing
705 (supporting the ability to infer the thoughts and feelings of others) (Paracampo et al., 2017).
706 Moreover, deficits in empathetic abilities are associated with alexithymia, characterized by
707 difficulties identifying and verbalizing one's own feelings (Preece et al., 2020; Valdespino et al.,
708 2017). These findings are compatible with the view that empathic accuracy relies on a simulation of
709 the target's emotions, which can, for instance, translate into facial mimicry. Moreover, interpersonal
710 autonomic synchrony between spouses during face-to-face interaction positively correlated with
711 empathic accuracy (Levenson & Ruef, 1992). On the other hand, previous research also demonstrates
712 that accuracy in emotion recognition does not rely on emotion alignment between perceiver and
713 target. Unlike the aforementioned TMS study, a functional Magnetic Resonance Imaging (fMRI) study
714 investigating the neural correlates of empathic accuracy showed a positive correlation with
715 activations in areas involved in mentalizing, such as the superior temporal sulcus, the
716 temporoparietal junction and the temporal pole, as opposed to areas involved in sensorimotor
717 representations (Mackes et al., 2018). In addition, studies pointed to dissociations between
718 interpersonal autonomic synchrony and empathic accuracy (Soto & Levenson, 2009). For instance,
719 cardiac synchrony between strangers increased under attentional focus to visual non-verbal cues,
720 whereas empathic accuracy increased with availability of verbal cues, as mentioned earlier (Jospe et
721 al., 2020).

722 In short, empathic accuracy decreases with social distance and increases with the exchange
723 of verbal cues between perceiver and target. Crucially, both have been described as features of
724 collective emotional episodes, especially considering the social sharing of emotion that characterizes
725 mutual and "we" collective emotions in our typology. However, to the best of our knowledge,

726 empathic accuracy has never been assessed in a bidirectional fashion as a marker of reciprocal
727 explicit awareness of emotion. Moreover, the processes underlying attribution of emotions to other
728 individuals may greatly differ in social settings involving large groups of individuals.

729 **3.5. Emotional aperture**

730 When collective emotional episodes extend beyond a dyadic relation, explicit awareness of
731 other individuals and their emotions (Sub-section 1.3) can be measured in terms of emotional
732 aperture, defined as the ability to accurately infer the emotional composition of a group (Sanchez-
733 Burks & Huy, 2009). Research on emotional aperture found that participants asked to evaluate the
734 emotional composition of a group of individuals tended to focus their attention on a few individuals
735 (Masuda et al., 2008), and in particular those expressing more intense emotions, which led to an
736 overestimation of the group's average emotional intensity (Goldenberg et al., 2021).

737 Like empathic accuracy, emotional aperture has been shown to vary with the traits of the
738 perceiver and the perceiver-target relation. A recent study that investigated the hypothesis that
739 emotional aperture is a culture-dependent ability, found that individuals from collectivist cultures
740 (i.e., Chinese participants) were more accurate than individuals from individualistic cultures (i.e.,
741 American participants) at inferring the emotional composition of a group, relying more on global, as
742 opposed to local visual processing (Yang et al., 2019). Furthermore, emotional aperture is subject to
743 in-group bias: participants overestimated the negative emotions and underestimated the positive
744 emotions of outgroup members (Seger et al., 2009).

745 In light of the aforementioned evidence regarding emotional convergence (see Sub-section
746 3.2), emotional aperture could constitute a prerequisite for successful emotional convergence based
747 on social appraisal in large groups. Moreover, perception of emotional convergence within a group
748 was found to positively predict inferences of psychological closeness between group members and a
749 shared common fate (Magee & Tiedens, 2006). Therefore, emotional aperture could also serve as a
750 basis for the experience of social connectedness that characterizes higher degrees of collective
751 emotion in our typology.

752 **3.6. Social connectedness**

753 The feeling of connectedness that characterizes the experiential quality of collective emotion
754 (Sub-section 1.2) is the focus of research on collective effervescence and identity fusion. Ritualistic
755 theories describe collective gatherings as prototypical occurrences of collective emotion involving in-
756 group emotion alignment, behavioural synchrony, rhythmic entrainment, mutual awareness with
757 joint attention and collective effervescence (Rosner & Meher, 2014; Knottnerus, 2010). Research on
758 collective effervescence therefore integrates several of the aforementioned fields of research with
759 the central claim that collective effervescence, including a feeling of social connectedness or sense of
760 togetherness, mediates the relation between emotion alignment and the reinforcement of social
761 cohesion within the group. Previous research has indeed confirmed that perceived emotion
762 alignment mediates the relation between participation in collective gatherings (e.g., folkloric
763 marches, political demonstrations) and social outcomes, such as identity fusion, the feeling of
764 belonging and collective self-esteem (Páez et al., 2015; Włodarczyk et al., 2021). These results
765 suggest that group-level emotional patterns, and awareness thereof, are pre-requisites for the
766 experience of social connectedness.

767 What are the mechanistic bases of social connectedness? First, as mentioned in Section 1.2,
768 social attention may underlie mutual awareness of emotion alignment during such collective events.
769 Supportive evidence comes from an experimental study contrasting groups of participants co-
770 attending to film clips on the same screen to those present in the same room but watching the film
771 clips on individual laptops: despite a decrease in perceived similarity and liking of other group
772 members when participants individually watched negative, as opposed to neutral film clips,
773 measures of social connectedness increased when participants jointly watched the negative film clips
774 compared to other conditions (Rennung & Göritz, 2015)¹⁴. Second, empirical evidence has linked
775 social connectedness with autonomic activation: periods of high self-reported togetherness within

¹⁴ This study also hints at the intriguing possibility that the enjoyment of negative emotional experience (e.g., watching horror films and attending tragic plays in the cinema and theatre) is not only a function of individual psychological processes (Menninghaus et al., 2017) but also involves interpersonal processes.

776 dyads were marked by an increase in participants' heart rate, which could be interpreted as evidence
777 for enhanced enjoyment and engagement during joint tasks (Noy et al., 2015). Moreover, autonomic
778 activation positively predicted the extent of meaning-making reflection that is typical of imagistic
779 rituals (Richert et al., 2005) and, ultimately, autonomic activation enhanced the relation between
780 identity fusion and pro-group behaviours (Swann et al., 2012).

781 In short, empirical evidence supports models of collective effervescence that posit the
782 contribution of mutual attentional focus and increased autonomic activation. However, further
783 research is needed to identify the relation between these different mechanisms and the dynamic
784 emotional experience of individuals reporting social connectedness.

785 In this section, we linked hypotheses about mechanisms of collective emotion with available
786 empirical evidence in different fields of research. Overall, the scientific literature provides evidence
787 that these different mechanisms contribute to the emergence of group-level emotional patterns that
788 characterize collective emotion: shared experience and in particular felt presence of co-attending
789 individuals drives up- and down-regulation of emotional responses (Sub-section 3.1); group-based
790 appraisal, mimicry and social sharing of emotion contribute to emotional convergence that
791 corresponds to consolidation of emotional responses (Sub-section 3.2); research on interpersonal
792 synchrony at the behavioural, autonomic and cerebral levels yields knowledge about the biological
793 correlates and prosocial effects of the synchronization of emotional responses (Sub-section 3.3);
794 research on empathic accuracy and emotional aperture elucidates the mechanisms underlying
795 explicit awareness of the emotions of other individuals (Sub-sections 3.4 and 3.5); research on
796 collective effervescence connects different candidate mechanisms into a functional framework (Sub-
797 section 3.6). Moreover, the aforementioned studies point to the existence of common contextual
798 factors: (i) social distance between partaking individuals, including kinship, friendship and
799 experimentally induced group identification; (ii) emotional characteristics of the context, such as
800 valence and arousal; (iii) modality of the social interaction, such as communication modality and
801 group size. Crucially, combinations of such factors predict changes in the aforementioned

802 mechanisms that are congruent with our typology of collective emotion. However, overlap between
803 these research areas in the context of collective emotion remains fairly exceptional, which calls for
804 developing a framework fostering systematic empirical investigation of collective emotion.

805 **Conclusion and future directions**

806 To conclude, we propose to address theoretical and methodological heterogeneity in
807 research on collective emotion by specifying the main social and cognitive processes involved. The
808 interplay between these processes yields a typology consisting of four degrees of collective emotion
809 that highlights commonalities between different traditions of research on this topic. Based on this
810 typology, we formulated empirical predictions about the mechanisms, factors and social
811 consequences of collective emotion and turned to available empirical evidence in social cognition
812 and affective sciences.

813 Based on this approach, we outline here several questions for future research. What is the
814 relation between the three main characteristics of collective emotion (i.e., emotion alignment,
815 feeling of connectedness, mutual awareness)? Are there continuous empirical measures reflecting
816 changes in degree of emotional collectiveness (e.g., alignment of emotional experiences, autonomic
817 and cerebral synchrony)? What are the neural correlates of collective emotion? What are the
818 temporal dynamics (e.g., time scale, directionality) and the exact social outcomes (e.g., social
819 cohesion, cooperation) of collective emotion given the degree of emotional collectiveness and the
820 socio-affective context (e.g., spatial and social distance between individuals, group size, levels of
821 arousal and behavioural synchronicity)? In particular, how does our typology of collective emotion
822 relate to typologies of joint action?¹⁵ What are some of the negative consequences of collective
823 emotions?¹⁶ What individual traits and cultural factors account for variability in experiencing

¹⁵ Future research could compare the relation between specific types of collective emotion and specific types of joint action (Pacherie, 2014). For example, does “we” collective emotion (i.e., feeling as one) foster collective action characterized by united agency (i.e., the sense of acting as one)?

¹⁶ Contemporary research on collective emotion mainly stresses its adaptive social role, although collective emotions may sometimes have detrimental personal and social effects. See Gelfand and colleagues (2020) for

824 collective emotion? A major challenge for research on collective emotion is testing the central
825 assumption that collective emotion fulfils social functions. Indeed, we reviewed empirical evidence
826 highlighting the prosocial attitudinal and behavioural effects of social identification, emotion
827 alignment, interpersonal synchrony, social sharing of emotion and the feeling of social
828 connectedness. Hence, the question arises whether collective emotion resulting from combinations
829 of these phenomena results in adaptive social outcomes above and beyond the aforementioned
830 effects.

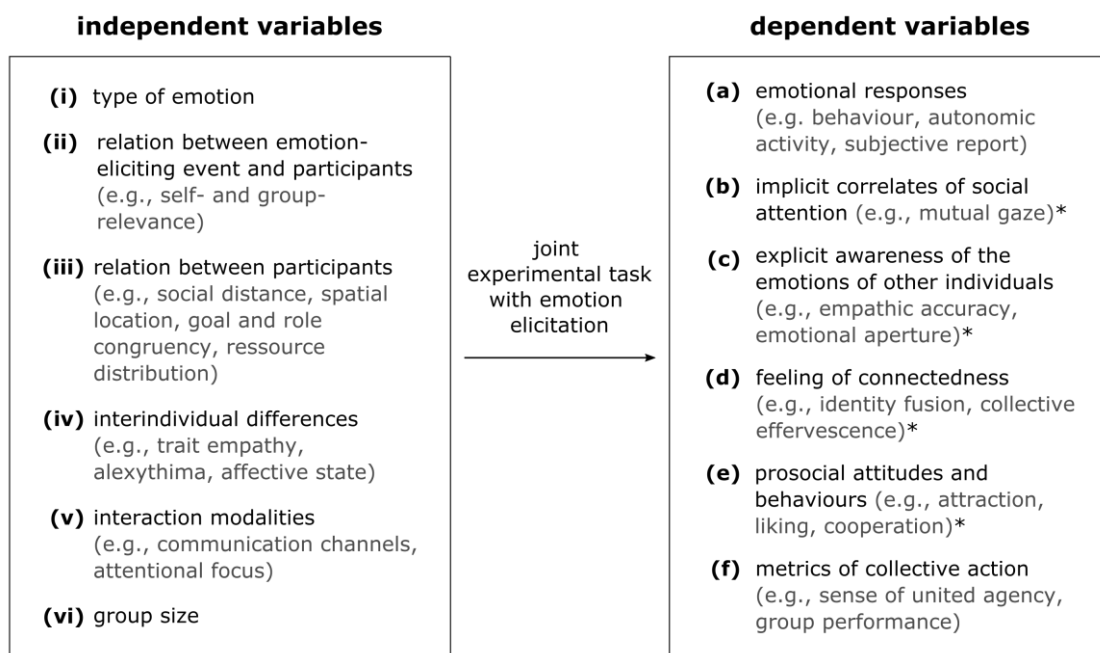
831 To address these pressing questions, we call for an integrative framework combining
832 empirical field studies and experimental research in laboratory settings. To date, field-based work on
833 collective ritualistic events in the social sciences has yielded fundamental insights into group
834 dynamics in affective contexts. However, their ecological validity comes at the expense of accuracy in
835 probing the implicit cognitive mechanisms occurring during collective emotion. It is therefore difficult
836 to generalize ritualistic models to explain the occurrence and outcomes of collective emotion in
837 other social settings. We propose that a fruitful research program would complement this research
838 with experimental studies manipulating the socio-affective context during joint experimental tasks.
839 Based on our review of the scientific literature, we have identified relevant independent and
840 dependent variables that are likely to modulate and characterize different types of collective
841 emotion (see Figure 2). The proposed research program has the advantage of capitalizing on existing
842 empirical measures, while combining them into dyad- or group-level indices measuring changes
843 during the collective emotional episode.

844 Finally, we stress the promising implications of experimental research on collective emotion.
845 To start with, the theoretical literature on collective emotion calls for dedicated empirical research to
846 put to test the assumptions and predictions of existing accounts. Furthermore, the experimental
847 study of collective emotion would contribute to extending empirical research in affective sciences

a related discussion and a review of the anti-social effects of ritualistic synchrony (e.g., destructive obedience, diminished creativity).

848 and social cognition towards group-level affective phenomena that characterize human ecologies
849 (van Kleef & Fischer, 2016; Schilbach et al., 2013b). Overall, this research program is likely to benefit
850 broader research in the social sciences and real-world applications by integrating different levels of
851 analysis into a multidisciplinary framework (Whitehouse, 2021; Todorov et al., 2006). We believe this
852 endeavour is crucial if we aim for a better understanding of human attachment, collective behaviours
853 and their transformation in modern society (Bak-Coleman et al., 2021).

854

855 **Figure 2**856 *Relevant experimental variables for the study of collective emotion*

857

858 *Note.* Dependent variables (a) to (d) refer to characteristics of collective emotion, whereas

859 dependent variables (e) and (f) refer to candidate social consequences. This list is not exhaustive.

860 * These variables denote individual-level measures that are then respectively aggregated into group-

861 level indices.

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