Joint attention, openness, and self-other (in)differentiation

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Abstract

Joint attention is characterised by openness: when two agents jointly attend to an object, they are immediately and fully aware of each other's attentional states. Existing accounts of openness involve a mental picture in which two agents attend to the same object and where openness is then 'added'. I argue that the experience of openness comes first. Young infants operate under a *tacit assumption of openness*: they behave as if attentional states were open even when they are not. The ability to engage in joint attention doesn't arise when infants begin to experience openness, but rather when they can limit these experiences to open interactions. For this, they depend on cognitive processes that detect non-open interactions. Some of these processes develop early and don't require the representation of others' mental states. Other processes develop later and require the infant to differentiate between herself and others as subjects of attentional states.

Introduction

As a friend and I walk down a narrow street, a beautiful cat crosses our path, seemingly oblivious to our existence. She races across the street and then up a nearby tree. I look to my friend, who turns towards me. We exchange a smile and observe the animal a little longer.

The smile that punctuates this episode marks a change in our interaction: we now *jointly attend* to the cat. While my friend and I might have both been attending to the cat before, we did not know this. Our attentional states weren't *out in the open*. They weren't, to put it in Sperber and Wilson's (1986) words, *mutually manifest*. Only when we exchange a smile does it become fully and immediately transparent to us that we are jointly attending to the cat (Calabi, 2008). My friend and I are now aware that we're jointly attending to the cat.

Broadly speaking, the literature knows two distinct kinds of approach to openness and joint attention. Knowledge-based accounts claim that two agents jointly attend to an object when they have mutual knowledge about one another's attentional states.

Non-reductive accounts, in contrast, argue that 'joint attention [is] a primitive phenomenon of consciousness' (Campbell, 2005, p. 288) that cannot be reduced to the agents' individual states.

Both approaches spring from a mental picture in which two agents attend to the same object but fail to *jointly* attend to it – and this is getting things backwards. My introductory example illustrates this problematic mental picture: my friend and I attend to the cat and later come to be aware that this is the case. When put like this, inquiry naturally focuses on how attentional states become open to the participants. Essentially, joint attention is attention to the same object to which we *add* openness. Instead, I propose that we start from situations in which an agent attends to an object and experiences joint attention without anyone else attending with them. The experience of joint attention comes first, and what is added later is the ability to limit the experience to situations in which there is another agent who is jointly attending.

Early infant behaviour that manifests what I call a *tacit assumption of openness* shows the promise of changing tack. Infants often behave in ways that pre-suppose that interactions are open: they behave in ways that only succeed in open interactions, but do so no matter whether that is the case. In early social referencing, for instance, an infant may take an adult's expression of fear to indicate that they shouldn't engage with an object even if the adult is not paying attention to the infant.

Joint attention requires that the infant be good enough at detecting non-open situations so that the experience of openness (that is, the experience that attentional states are out in the open) is limited to open interactions (that is, interactions in which attentional states are out in the open). This happens once infants develop and apply two kinds of sensitivity to detect such situations. First, infants become sensitive to being at the other's focus of attention (*sensitivity to attention-to-self*). This sensitivity isn't cognitively demanding. Later, infants become sensitive to sharing the other's focus of attention (*sensitivity to attention-to-same-object*), which requires that they differentiate between themselves and others as distinct subjects of attentional states.

The proposed account comes with several advantages. It allows giving an account of the psychological processes that neither asks too little nor too much of infant cognitive abilities. It agrees with the basic insights of non-reductive accounts (that the experience of openness isn't due to an agent's representation of the other's mental states) *and* knowledge-based accounts (that the ability to engage in joint attention requires some knowledge of other minds). The proposal doesn't rely on the controversial metaphysical position of relationalism about perception (unlike Campbell's account and those inspired by him). Finally, the account explains the experiential nature of openness and of how joint attention can provide a rational basis for joint action.

An improved account of joint attention may benefit a wide range of philosophical and psychological debates. Various authors have argued that joint attention helps explain mutual knowledge (Peacocke, 2005; Seemann, 2019), communication (Camp-

bell, 2017; Eilan, n.d., 2005, 2007; Heal, 2005; Tomasello, 1995), theory of mind (Baron-Cohen, 2000; Campbell, 2012, 2017; Franco, 2005; Heal, 2005; Hobson, 2005; Leavens & Racine, 2009; Moll & Meltzoff, 2011), and joint action (Battich & Geurts, 2021; Campbell, 2005; Fiebich & Gallagher, 2013). Joint attention is hence both of intrinsic interest and implicated in the explanation of a variety of other phenomena.

Following this introduction, section 1 discusses why openness presents such a puzzle and where the strengths and weaknesses of prior accounts lie. Thereafter, in section 2, I focus on dyadic interactions in early infancy and how they are characterised by a tacit assumption of openness. Here, we also encounter the sensitivity to attention-to-self. In section 3, I turn to triadic interactions, and in section 4, I show how joint attention emerges with the sensitivity to attention-to-same-object. Section 5 examines the account's upshots, and section 6 concludes.

The puzzle of openness

Openness makes joint attention puzzling, and the account proposed in this paper is, above all, an account of openness. It's therefore important to look at what makes openness puzzling and identify where existing accounts fall short.

Consider a case in which openness doesn't obtain. Nakisha and Subhan are secretly in love. They work in the same office and spend a great deal of time surreptitiously observing one another. This has made them adept at detecting one another's focus of attention. Right now, they are both looking at the daily inspirational quote on the whiteboard. Nakisha knows Subhan is attending to the whiteboard, and Subhan knows Nakisha is attending to the whiteboard. However, neither Nakisha nor Subhan is aware of this: Nakisha isn't aware that Subhan knows that she is attending to the whiteboard, and Subhan isn't aware that Nakisha knows he is attending to the whiteboard.[1]

Why does Nakisha and Subhan's interaction lack openness? We might think the answer is straightforward: Nakisha isn't aware that Subhan is aware that she is attending to the whiteboard (likewise for Subhan). However, even if she (and Subhan) were so aware, attentional states might still not be fully open: for instance, Nakisha may fail to be aware that Subhan is aware that she is aware that he's attending to the whiteboard. And on it goes: with each additional iteration of awareness, there remains another iteration that is also required for joint attention.

The two kinds of approach to joint attention tackle this puzzle in distinct ways. Knowledge-based accounts aim to reduce openness to the participants' individual mental states. Most commonly, this comes down to the claim that attentional states are out in the open if the participants have the right kind of mutual knowledge. At this point, there is a juncture. First, one might think that openness requires infinite

[1] This example is inspired by similar cases by Peacocke (2005), León (2021), and Eilan (n.d.).

knowledge: an agent is aware of jointly attending to some object because they know that the other attends to the same object, and they know that the other knows that they attend to it, and so forth.[2] This approach becomes problematic once we consider what an agent needs to represent to have the relevant knowledge. If it were just about attributing beliefs or knowledge, we might succeed at accounting for infinite knowledge with finite representations. Arguably, an agent may know, for instance, that there are more than a thousand grains of sand on earth even if they do not represent this fact. It's enough that she is disposed to infer it. However, we're concerned with awareness – an experiential state – and an agent can only be aware of some state of affairs if she *actually* represents it (Peacocke, 2005). Full awareness of openness would then require infinitely many representations, which is impossible given our limited cognitive capacities. For this reason – and since it's unclear whether anyone espouses the view (Battich & Geurts, 2021) – I will not discuss it any further.

Knowledge-based accounts that require participants to have some finite knowledge (Gilbert, 2007; Peacocke, 2005; Tomasello, 1995) are more popular but still face several important worries. According to such accounts, agents are aware of joint attention when they have some (limited) knowledge about the co-attender. From this knowledge, an agent may then infer all the infinite iterations of awareness characteristic of openness. While this dispenses with the need for infinitely many (actually tokened) representations, such accounts have been argued to suffer from an overly high level of cognitive sophistication (Eilan, 2005; León, 2021), an inability to make sense of the observation that agents *experience* openness in joint attention (Peacocke, 2005), and a failure to account for how joint attention may provide a rational basis for joint action (Campbell, 2005). We will return to these worries in more detail later on.

Due to these difficulties, much of the literature has pivoted towards explanations based on irreducibly non-individualistic states (Calabi, 2008; Campbell, 2005, 2012, 2017; Eilan, n.d.; Gómez, 2005; Seemann, 2012). Campbell, for instance, argues that joint attention is a perceptual phenomenon and, hence, doesn't involve any personal-level inferences or judgements. Moreover, for him, perceptual states are relational, and it's therefore impossible to specify an agent's perceptual state without reference to the perceived object. When an agent perceives joint attention, the other agent must figure as a co-attender in the content of the experience. While other accounts in this family may differ significantly, they all agree that knowledge of the other's mental states cannot explain an agent's experience of joint attention.

While I agree that knowledge of a co-attender's mental states fails to explain openness, I am dissatisfied with existing non-reductionist approaches. To some extent, this is due to the worry – shared by others (Battich & Geurts, 2021; Eilan, n.d.; Gómez, 2005; León, 2021; Vincini, 2024) – that such accounts fail to explain which, and how, psychological processes underpin openness. If we simply posit that unanalysable non-

[2] I use the singular 'they' for unnamed adults and 'she' for infants.

reductive states explain openness, we risk leaving joint attention no less mysterious than it was before.

I also worry that non-reductive accounts conflict with some of the empirical literature. Findings in developmental psychology indicate a close link between joint attention and infants' abilities to *represent the co-attender's attentional state* (Tomasello, 1995; Woodward, 2005). Infants need to develop such representational capacities before they can engage in joint attention. While infants do not have the sophisticated meta-representational abilities that would corroborate knowledge-based accounts, representations of *some* individual mental states *are* important to explaining joint attention (see also Battich & Geurts, 2021). We may now wonder: if 'joint attention [is] a primitive phenomenon of consciousness' (Campbell, 2005, p. 288), why are representations of other's mental states so important for an infant to engage in joint attention? Existing non-reductive accounts don't explain why and how such representations are important to joint attention.

An account of joint attention must do many things. It must capture the character of the experience of openness, be set at the right level of cognitive sophistication, illuminate the psychological processes (or, at least, show how we could achieve this in principle), and explain how joint attention may provide a rational basis for action. We'll see in section 5 whether my account lives up to these demands.

The assumption of openness in dyadic interactions

Young infants engage exclusively in dyadic interactions, namely face-to-face interactions with their caregivers. Only later do they engage in triadic interactions, which relate them to another person and an object. While joint attention is a triadic interaction, we'll see that openness – more specifically, the tacit assumption of openness – also characterises dyadic interactions.

In emotional contagion, an infant automatically absorbs the emotional states expressed by others (Hatfield et al., 1993). For instance, when a neonate cries, other newborns located within earshot reliably also begin to cry (Bühler & Hetzer, 1928; Simner, 1971). While contagious crying might be the only form of emotional contagion at birth, various other forms soon develop (Fonagy et al., 2007; Heyes, 2018). Infants' responses to others' – especially their caregivers' – facial expressions are of particular importance to us (Leppänen & Nelson, 2009). To give the gist of it, infants tend to cheer up when their caregivers smile and become fearful when caregivers frown.

Through emotional contagion, caregivers may help regulate infants' affective states when the infants' capacity to regulate their own emotions is still severely limited (Heyes, 2018; Taipale, 2016). A caregiver's reassuring smile may, for instance, help calm an infant who has been startled by a loud noise. The infant is drawn to exhibit an emotion of the same, positive, kind and is thus being pulled towards an

emotion that is appropriate for a non-threatening situation.[3]

Adults only succeed at regulating an infant's emotions when they express an emotion that is appropriate for the infant. The caregiver only reliably expresses such an emotion if they are aware of both the infant's object of attention (the source of the startling sound) and the infant attending to the caregiver. When these conditions occur, the caregiver is likely to express an emotion that is about the infant-object relation and is meant to be taken up by the infant.

When these factors do not obtain, the caregiver is likely to express – and the infant is likely to adopt – an inappropriate emotion. For instance, if a caregiver expresses stress and anxiety while on a work-related phone call, a happy infant may become distressed. In this situation, distress isn't an appropriate emotion for the infant.

Young infants inflexibly take on others' emotional states, which shows that they tacitly assume the world to be a certain way. Emotional contagion is only appropriate when the caregiver attends to the same object and is aware of the infant's attentional state. The infant, however, adopts the caregiver's emotional state even if these conditions aren't fulfilled. She tacitly assumes that these conditions are fulfilled across all interactions.

These assumptions involve the tacit assumption that openness is the case. To fully articulate this claim, we will need two distinctions. First, we may distinguish between agent *A*'s and agent *B*'s awareness of joint attention. Agent *A* is aware that agent *B* jointly attends to the object, and agent *B* is aware that agent *A* jointly attends to the object. The distinction here is merely conceptual: If it's the case that *A* is aware of the relevant state of affairs, then *B* is also so aware (and *vice versa*). This implication follows from the fact that awareness is factive and that *A*'s awareness includes, as content, the fact that *B* is aware in the same way.

Second, we may distinguish between openness as an experience and a state of affairs. Awareness, as just mentioned, is a factive experiential state. An agent who is aware of a chair experiences a chair, and this chair causes (in the right sort of way) the experience. We may hence distinguish between an experiential component – which I take to be non-factive – and a state of affairs. This distinction, unlike the previous one, isn't merely conceptual: we may experience attentional states to be open when they are not open.

Infants' tacit assumption of openness has a behavioural and experiential aspect. First, infants behave across both open and non-open interactions in a manner that will only reliably succeed in open interactions. We have seen an example of this above when we looked at how infants inflexibly take on others' emotional states. Infants behave, across both open and non-open interactions, as if the other shared their object

[3] Emotional contagion isn't the only, nor the most important, way in which an adult may help regulate an infant's emotions (Fonagy et al., 2007). For instance, it's more common – and more effective – for a parent to soothe her infant by picking her up. The claim that I develop over the next paragraphs – that emotional contagion manifests a tacit assumption of openness – is not affected by these complications.

of attention and as if the other were aware of their attentional state.

Additionally, infants also *experience* interactions to be open no matter whether they are open or non-open. I am here inspired by the views of Campbell (2005), Seemann (2012), and Roessler (2005), who employ the concept of sensorimotor representation to explain infants' ability to engage in joint attention. According to these accounts, infants experience caregivers as the source of certain affordances. The caregiver, for instance, affords emotional regulation: the infant expects to be comforted when crying in their presence.

I argue that these caregiver-related affordances involve a tacit assumption of openness. For instance, young infants experience the caregiver to afford emotional regulation no matter whether the caregiver is aware of the infant's attentional state. The tacit assumption of openness is implicit in the affordances presented to the infant, and the infant consequently (pre-reflectively) experiences interactions to be open no matter whether they really are. Unlike existing affordance-based accounts, I argue that the relevant sensorimotor representations arise early on (rather than around the age of one year when joint attention behaviour arises). Infants token the relevant sensorimotor representations before they become able to detect when the representations do not accurately capture the state of the world.

I want to emphasise that the assumption of openness is tacit.[4] Being tacit, the assumption only manifests in the agent's behaviour (and a specific kind of experience) and is rooted only in sensorimotor representations. The infant does not *represent* a differentiation between her own and others' attentional states, which she then uses to represent that these states are open to the respective other. She neither experiences two distinct agents with their respective attentional states nor does she have a conception of the fact that attentional states may not be open. The tacit assumption of openness manifests a lack of self-other differentiation rather than the overcoming of such a differentiation.

When an infant mistakenly assumes that openness is the case, she may engage in inappropriate behaviour. To avoid this, various processes that detect non-open situations develop. For instance, she may detect when the other doesn't attend to her, and change her behaviour in these situations. An infant who sees their absent-minded caregiver express anxiety can then avoid taking on this emotional state.

The infant's ability to only selectively assume her caregiver's emotional state builds on the infant's developing ability to detect when others attend to her. Evidence for this exists from birth (Farroni et al., 2002). From two months of age, we can witness the infant responding to others' (lack of) attention in increasingly varied ways (Reddy et al., 1997; Reddy, 2005). The infant smiles in mutual gaze, averts her

[4] What I call *tacit* (after Dennett, 1982), others call *implicit* (Dienes & Perner, 1999; Musholt, 2013; Seemann, 2012). The notion of tacit assumption also has intriguing links – that space constraints bar me from elaborating – to the notions of *fictionalism* (Eklund, 2015; Sainsbury, 2010; Yablo, 2001) and *unarticulated constituents of thought* (Dienes & Perner, 1999; Perry & Blackburn, 1986; Recanati, 2002).

gaze when attention becomes too much, and calls her caregiver when they are absent or inattentive.

Infants develop what I call a *sensitivity to* (*failure of*) *attention-to-self*. When the infant employs this sensitivity to lessen emotional contagion in non-open situations, she starts to overcome her assumption of openness. She can now detect *some* situations in which her assumption of openness is false – namely when the other fails to attend to her – and respond more appropriately. This increased behavioural flexibility doesn't, as such, repose on an ability to detect when the other attends to oneself. It is, instead, based on the ability to detect when the other *fails* to attend to oneself. It's when the infant detects such failures that her behaviour departs from the tacit assumption of openness.

First triadic interactions

Triadic interactions (between an infant, a caregiver, and an object) develop in a manner that parallels dyadic interactions' development. Initially, infants tacitly assume that openness is the case, and only later do they gain the ability to detect situations in which the assumption is false.

Infants encounter a multitude of objects once they start crawling at around the age of 7 months (Adolph et al., 1998; Adolph & Franchak, 2017). These objects evoke emotions, which guide the infant's engagement with her environment. On seeing a toy, an infant may become excited and move towards it, whereas a dog can instil negative emotions and cause the infant to retreat. However, emotional states aren't always this clear. When an infant encounters a novel object, she may end up in an ambiguous emotional state that fails to indicate a clear course of action.

To resolve emotionally ambiguous states, infants may engage in *social referencing*: they turn to their caregiver for emotional cues that indicate an appropriate emotional response (Feinman, 2013; Hornik et al., 1987; Klinnert et al., 1983; Striano & Rochat, 2000; Walden & Ogan, 1988). Social referencing leads to characteristic behaviour: infants tend to explore unknown objects when seeing their caregiver express a positive emotion and to disengage on perceiving a negative emotion.

Interestingly, social referencing is at first unaffected by others' attentional states. Striano and Rochat (2000) investigate how infants respond to a barking dog toy (combining features of an exciting toy and a scary dog). They found that 7-month-olds engage in social referencing whether the adult is looking at the infant or absent-mindedly reading a newspaper. This indicates that 7-month-olds do not modify their (social referencing) behaviour when others fail to attend to them. Infants seem to be as insensitive to attention-to-self in early triadic interactions as they are in early dyadic interactions. They engage in social referencing even when the adult doesn't attend to the same object or isn't aware of the infant's attentional

state.

At 10 months of age, infants begin to adapt their social referencing to others' attentional states. Striano and Rochat (2000) show that infants develop a sensitivity to attention-to-self by this age: they only turn to the adult for social referencing if the adult attends to the infant. When adults are absent-minded, infants no longer use their expressions to disambiguate emotional states and guide responses to the barking dog toy.

In addition to the sensitivity to attention-to-self, joint attention requires a *sensitivity to* (*failure of*) *attention-to-same-object*. Infants need to be sensitive 'to the fact that the adult may not be attending to what engrosses the child' (Eilan, 2007, p. 133). Striano and Rochat (2000) don't show that infants are sensitive in this way. Their experiment fails to establish that the infant can distinguish between a situation in which the other is merely aware of the infant (but not the toy) and a situation in which the other is aware of the infant *and* the infant's object of attention.

If 10-month-olds fail to be sensitive to attention-to-same-object, they could mistakenly assume openness, which leads to inappropriate behaviour. They might engage in social referencing when the other fails to attend to the same object. In this situation, the adult is likely unaware of the infant's object of attention and, hence, likely expresses an emotion that isn't about the infant-toy relation. Imagine an infant attending to a (scary, non-toy) dog. If the adult isn't aware of the infant's object of attention, they might engage with the infant by smiling, which could lead the infant to approach a potentially dangerous object. The infant then engages in inappropriate behaviour that manifests a tacit assumption of openness. The infant behaves in a way that is only appropriate if the adult attends to the same object regardless of whether this is the case.

Joint attention

We've seen that young infants tacitly assume that others attend to the same object. Infants develop the ability to engage in joint attention once they can detect when the other *does not* attend to the same object. The present section looks at how infants develop this sensitivity to attention-to-same-object and become able to engage in minimal forms of joint attention.

To understand the next step in attention cognition we have to take a step back and look at how infants start to follow others' gazes. Gaze-following develops around the age of 6 months when infants begin to inflexibly follow others' gazes (Butterworth & Jarrett, 1991; Senju & Csibra, 2008). The infant is here pushed to shift her own attention so that she ends up attending to the same object as the adult.

Automatic gaze-following is rooted in self-other indifferentiation in the same way as other inflexible forms of behaviour. A young infant possesses only a limited capa-

city to endogenously direct her attention so that salient objects and events attract her attention with little voluntary, top-down control (Krueger, 2013; Posner & Rothbart, 1998). The infant's limited capacity for top-down control of attention combines with a predilection for certain features associated with other human beings – famously a preference for human faces (for instance, Fantz, 1961; Valenza et al., 1996) – to pull the infant to attend to others' objects of attention. The result is a purely behavioural response to the other's gaze and doesn't rely on the infant being able to conceive of the other's gaze as indicative of an attentional state.

Unlike some of the previously discussed behaviours, inflexible gaze-following doesn't manifest an assumption of openness. Infants don't inflexibly behave as if the other attended to the same object. After all, infants turn to attend to the same object as the other, which would make no sense if they tacitly assumed to already be attending to said object.

Gaze-following doesn't manifest an assumption of openness but rather makes it more likely that the assumption comes out true. When an infant follows an adult's gaze, both agents end up attending to the same object, thus bringing it about that at least one condition on openness in joint attention (namely two agents attending to the same object) obtains. Hence, gaze-following is an important part of the ability to jointly attend to objects.

Gaze-following doesn't imply that the infant is sensitive to attention-to-same-object. It doesn't require that the infant represent the *relation* between her own and the other's attentional states; it merely requires detecting the other's gaze direction and responding to it (viz. Tomasello, 1995). What the infant needs, to develop sensitivity to attention-to-same-object, is an understanding of the other (and oneself) as subjects standing in attentional relations to objects. Only when the infant represents attention as a relation can she be sensitive to attending (and failing to attend) to the same object as some other agent.

Infants understand attention as a relation by grasping gaze as *directed at* objects. Woodward (2003, 2005) conducted an experiment to elucidate how this understanding develops around the age of 9 to 12 months. First, during a habituation phase, an adult attends to one of two toys (say, toy A). Once the infant is habituated, the experimenters swap the positions of toys A and B. During the test phase, the adult looks either towards a new toy (toy B, located where toy A had been previously) or a new side (toy A, located where toy B had been previously). Starting at around 12 months, infants look longer on new-toy trials than on new-side trials. The result indicates that infants recognise that there is something novel in the new-toy trials. Given that nothing changed regarding the side to which the adult attends, Woodward concludes that infants noticed a change in the relation between adult and toy.

An infant's sensitivity to attention-to-same-object builds on the representations that allow her to detect changes in other agents' attention relations. To detect when another agent's attention relation changes, the infant must be able to compare atten-

tion relations across two moments in time. These comparisons require the infant to instantiate a structured representation with tokens standing for the other agent and their objects of attention. With such representations, the infant can detect when another agent attends first to one object and then to the other. It's this structured representation that provides the infant with an understanding of gaze as object-directed. When an infant tokens such structured representations (and tokens them both for the other and oneself), she can compare her own object of attention with that of the other agent and thus become sensitive to attention-to-same-object.

We now have all the puzzle pieces required for an infant to engage in early forms of joint attention. Consider the following case (adapted from Bakeman & Adamson, 1984): The caregiver looks towards the infant, and the infant meets the adult's eyes. The caregiver smiles and looks at a toy truck, prompting the infant to shift her gaze too. The infant picks up the toy and starts pushing it around. The infant then looks back and forth between the caregiver and the truck. When their eyes meet again, the infant smiles excitedly at the caregiver, who reciprocates with a similar facial expression.

When the infant smiles at the caregiver, she engages in behaviour that succeeds (almost) only in open interactions. Only if the caregiver is aware of the infant's focus of attention and is aware of the infant being likewise aware of the adult's focus of attention, can the infant depend on her smile being correctly understood by the adult. In this situation, the caregiver correctly understands the smile as communicating the infant's excitement about the toy.

A variety of psychological processes enable the infant to ascertain that an interaction is open. Gaze-checking and the detection of eye contact, in particular, are important since they implement aspects of the two sensitivities discussed. They thus help ensure that the infant doesn't engage in behaviour whose success depends on openness in situations where the other fails to attend to the infant (failure of attention-to-self) or the same object (failure of attention-to-same-object).

Being able to detect eye contact is crucial for the sensitivity to attention-to-self and, hence, for joint attention. The infant's first bouts of joint attention are almost invariably initiated by the adult through eye contact (Striano et al., 2006; Striano & Stahl, 2005). When the adult fails to meet the infant's eyes, the infant may think that the situation isn't open and fail to engage in the kinds of behaviour required for joint attention. When the adult meets the infant's eyes, the infant won't classify the interaction as non-open and joint attention behaviour can proceed. Thus, when the adult shifts their gaze from the infant to some object, the infant may follow the adult's gaze, adding an object to the dyadic interaction and turning it into one of joint attention.

Note that eye contact doesn't, as such, allow the infant to know that an interaction is open. Rather, eye contact's importance lies in how an *absence* of eye contact indicates an *absence* of openness. This is not to say an experience of openness cannot be brought about by two agents' eyes meeting. However, such a case must be preceded by an earlier classification of the situation as non-open. Only when they first classify the

interaction as non-open can they later rescind that classification when eye contact is established. Even young infants experience attentional states as open, and these experiences do not depend on the establishment of eye contact.

Gaze-checking is a second important behavioural aspect of joint attention (Masur, 1983; Matthews et al., 2012). In gaze-checking, an infant alternates her gaze between an object and an adult to ascertain whether the adult's focus of attention is, as the infant's, on the object in question. As infants grow older, gaze-checking becomes increasingly sophisticated, manifesting an overcoming of the assumption that the other attends to the same object. For instance, while infants may at first only check the other's gaze *after* trying to establish attention to a common object, they later also check the adult's gaze *before* attempting to direct the other's attention (Franco, 2005). Here, too, the infant doesn't use attention-to-same-object to indicate that an interaction is open. Rather, a failure of attention-to-same-object indicates that she should stop assuming that an interaction is open. Detection of a failure of attention-to-same-object thus operates in a manner analogous to the detection of a failure of attention-to-self.

Upshots

I've shown that infants initially tacitly assume that attentional states are out in the open. At times, this assumption turns out to be false, and in the course of development, infants begin to employ various sensitivities to detect non-open interactions. Once the infant uses her sensitivity to attention-to-self and attention-to-same-object to identify non-open situations, she develops a minimal ability to engage in joint attention.

However – and this is why I've spoken of a *minimal* ability for joint attention – even with the two sensitivities just mentioned, infants don't gain an ability to detect open situations as such. Consider the following case: an infant and a caregiver are attending to the same object, and each is aware of the other attending to said object, but neither is aware that the other is aware of their attentional state. An infant furnished only with the two sensitivities discussed so far cannot identify this interaction as non-open. The reason openness is lacking is at a level of iteration beyond the infant's sensitivities.

It may help to think of the infant's budding ability to detect non-open situations in the following way: In the beginning, the set of interactions in which the infant behaves as if they were open includes (almost) all interactions. As the infant matures, that set is progressively whittled down to exclude increasingly many non-open interactions. Eventually, the set of interactions in which the infant assumes that openness obtains approaches the set of open situations.

The infant will not have excluded all non-open interactions from those in which she assumes openness when she becomes sensitive to attention-to-self and attention-to-same-object. In fact, even the development of more sophisticated sensitivities can-

not bring this process of exclusion to an end. Consider an infant who has the cognitive wherewithal to represent when the caregiver fails to be aware of her awareness of the caregiver's object of attention (and thus correctly classify the above interaction as non-open). Even in this case, the infant has not developed the ability to detect open situations as such. Her ability to detect non-open situations has improved – but there remain non-open interactions that she cannot even in principle detect.

A certain remnant of the assumption of openness remains no matter how sophisticated an agent's ability to detect non-open situations becomes. But this doesn't matter (or doesn't matter much): if recognition of the relevant situations is good enough to get things right in most of the (important) cases, responses will generally be appropriate.

My proposal unites features of reductive and non-reductive accounts. On the one hand, it claims that knowledge of one's co-attender's mental states doesn't bring about experiences of openness (because such experiences are basic). On the other hand, it claims that these experiences are due to sensorimotor representations, which, on the face of it, are entirely due to an agent's individual states. But an account cannot be both reductive and non-reductive – so, which is it?

When asking whether a certain account of joint attention is reductive, we're asking whether the account posits that we can reduce each agent's awareness of joint attention to this agent's individual states. To address this question, we must start from a situation in which two agents attend to the same object. This is needed because we're interested in *awareness* of openness, which is a factive state requiring that another agent co-attend to the same object. We then enquire whether each agent's awareness of openness can be explained by reference to that agent's states 'without this already implying that there is joint attention' (Campbell, 2005, p. 288). In other words, for an account to be reductive, we must be able to specify which of an agent's states constitute, or give rise to, awareness of joint attention without thereby implying that another agent is jointly attending with them.

According to the account I propose, the experience of openness is basic in the sense of being logically (and developmentally) prior to any experience of non-openness. The experience of openness is rooted in indifferentiation, and the experience of non-openness requires the development of differentiation. Moreover, even young infants can be *aware* of openness, namely when there is another agent who attends to the same object while being aware of the infant's attentional states. The fact that experiences of openness are basic doesn't imply that this awareness is primitive in Campbell's (2005, 2012, 2017) sense of not being reducible to individual states. An agent is aware that attentional states are open when they are presented with certain (accurate) affordances, and these affordances in turn depend on sensorimotor representations. Given the right sensorimotor representations, an agent behaves in a way that manifests a tacit assumption of openness. We can specify these sensorimotor representations without implying the existence of another agent who

co-attends to the same object.

Since experiences of openness do not require any knowledge of others' mental states, my account manages to be reductive without having to wrestle with infinitely iterated knowledge structures. Infants initially *experience* openness across a wide variety of both open and non-open situations, and they do so without having any knowledge of others' mental states. Infants are *aware* of attentional states being open when they experience them being open in a situation where they are indeed open. It's therefore possible to be aware of attentional states without having any knowledge of others' attentional states.

The account becomes no less reductive if we look at what's required for an infant to engage in minimal joint attention. A mature infant can engage in joint attention because she applies the sensitivities to attention-to-self and attention-to-same-object to restrict her experiences of openness to the appropriate interactions. She is disposed to not experience joint attention when joint attention isn't the case. The states that give rise to this disposition – the disposition's causal basis (Choi & Fara, 2018) – are also individual states of the agent. They are the states that underlie the two sensitivities, and there is *prima facie* no reason to think that these shouldn't be reducible to an agent's individual states.

Campbell claims that only a relational (and, thus, non-reductive) account of joint attention can make sense of how joint attention provides a rational basis for joint action. We are now in a position to see why this claim is false. Image that my friend and I are attempting to catch our missing cat, an endeavour whose success depends on us both acting jointly. Let's say I spot the cat, look towards my friend, meet their eyes, and move to catch the cat. When our eyes meet, our interaction loses the property that previously caused it to be classified as non-open. I consequently experience the interaction as open and spring into action. The same applies to my friend. It's rational for us to attack because we both – given our mature ability to detect non-open situations – instantiate processes that make it so that we reliably only experience attentional states to be open when this is the case.

Campbell's challenge has no bite since, on my account, the experience of openness comes first and doesn't depend on any representation of others' mental states. His challenge is premised on the idea that we must have an *immediate and full* awareness of openness for joint attention to be able to provide a rational basis for action. When we experience joint attention, we can be immediately presented with a rational basis for action. If a (knowledge-based) account implies that the relevant knowledge of the other's attentional states must first be inferred, it cannot account for how joint attention *immediately* provides a rational basis for joint action. On my account, however, the rational basis for joint action stems from a disposition to not experience attentional states to be open when they are not – and not from the inference of iterative knowledge structures. As long as an agent is disposed in the right sort of way, an experience of openness can present them with a rational basis for joint action.

Moreover, unlike relational accounts, my proposal explains why and when experiences of openness are reliable enough to ground rational action. It doesn't just explain why the experience of openness may provide a rational basis for joint action *if that experience is accurate*.

According to a relational account of perception, we must distinguish between two subjectively indistinguishable possibilities (viz. Crane, 2006). First, an agent may be perceiving the other as jointly attending to some object. This perceptual state is necessarily a relational state and as such factive – that is, when an agent *perceives* attentional states to be out in the open, they are necessarily *aware* of another agent jointly attending to an object. Second, as Campbell admits, an agent may believe they are experiencing attentional states to be open but be mistaken about this experience. Given that perception is relational, this is not a perception of joint attention.[5]

If Campbell's account is to explain how joint attention can provide a rational basis for joint actions, agents must reliably perceive joint attention rather than find themselves in the subjectively indistinguishable non-perceptual state. Otherwise, they'd regularly behave as if they were jointly attending to an object when joint attention isn't the case. What is problematic about Campbell's account is the failure, beyond insistence on what he sometimes calls monitoring and control processes (Campbell, 2005), to explain why we *reliably* perceive joint attention. My account does better on this score. It describes at least some of the psychological processes that ensure that (mature enough) agents experience openness only when openness indeed obtains. The two sensitivities I discuss (and the psychological processes underpinning the sensitivities) are the monitoring processes to which Campbell alludes.

Admittedly, my proposal is lacking a thorough treatment of the kinds of process that coordinate agents' attentional states. Monitoring processes alone do not reliably bring about joint attention – there must also be processes that cause agents to attend to the same objects. In an earlier section, I briefly mentioned how infant gaze-following is one such process, but many other processes coordinate attentional states. Especially early on, caregivers follow infants' attentional states to such an extent that infants may be able to engage in joint attention without having to deploy sophisticated monitoring processes at all (Bakeman & Adamson, 1984). Later on, other processes become more important, for instance pointing and point-following (see, for instance, Gómez, 2005)).

A lot more will certainly need to be said about monitoring and coordination processes for us to approach anything resembling a satisfying account. As it stands, my account at least provides a clear framework for how we may further our understanding of the relevant processes.

My account is pegged at a level of cognitive sophistication that is *just right*. The psychological processes involved in the sensitivity to attention-to-self (such as detec-

[5] This is an instance of relationalism's well-known disjunctivism about veridical and non-veridical perception.

tion of eye contact) do not depend on sophisticated representations of oneself and the other as subjects of attention. These processes develop early in infancy. In contrast, infants' sensitivity to attention-to-same-object does depend on the representation of other's attentional states, develops comparatively late, and implies an explicit differentiation between oneself and the other as subjects of attention.

A puzzle remains concerning the difference between genuine experiences of openness and those where attentional states aren't fully out in the open. How is it possible, given that my account implies that openness is experienced as long as non-openness isn't detected, that Subhan and Nakisha do not experience their interaction as open? After all, they represent each other as attending to the same object, and seemingly nothing they represent indicates a non-open interaction. And, if nothing rules out openness, then, on my account, it seems they should be experiencing openness. But they do not.

The solution to the puzzle lies in the diversity of the psychological processes with which we identify non-open interactions. While some of these depend on representations of others' mental (more precisely: attentional) states, others – such as the processes involved in the detection of attention-to-self – do not. Even if Subhan and Nakisha do not represent any mental states that would rule out openness, they might be detecting non-openness by some other (non-representational) process. An agent may represent mental states to be in line with openness while still failing to experience the situation as open.

Consider what could turn Nakisha and Subhan's interaction into an open one. Imagine Nakisha and Subhan looking up at the same time so that their eyes meet. When this happens, their experience of the situation shifts. They are now aware of being at the other's focus of attention, and the fact that they both co-attend to the whiteboard is now open to them. They now jointly attend to it.

Before their eyes met, Nakisha and Subhan attended to each other covertly. This covertness implies they never had the kind of eye contact that can establish that each is aware of the other. When their eyes meet, this changes. The interaction loses the property that made them rule out openness, and the situation is consequently experienced as open, giving rise to joint attention.

Concluding remarks

Young infants tacitly assume that openness is the case. They experience openness, and behave as if openness were the case, even in interactions that aren't open. This assumption is progressively limited to interactions in which it is appropriate. When infants become good enough at ensuring that their experiences of openness track the state of the world, the ability to engage in joint attention arises. Some of the psychological processes involved in the detection of non-open interactions do not require the

representation of other's mental states. Other processes, in contrast, require that the infant represent a differentiation between her own and the other's attentional states.

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