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Mindshaping, Coordination, and Intuitive Alignment

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Abstract

In this chapter, we will summarize recent empirical results highlighting how different groups of people solve pure coordination games. Such games are traditionally studied in behavioural economics, where two people need to coordinate without communicating with each other. Our results suggest that coordination choices vary across groups of people, and that people can adapt flexibly to these differences in order to coordinate between groups. We propose that pure coordination games are a useful empirical platform for studying aspects of mindshaping. Drawing on existing psychological literature on alignment during interactions, we suggest that experience of successful interaction leads people to develop aligned intuitions about what is relevant and appropriate that support coordination when interaction and communication is not possible. Consistent with arguments made in the literature on mindshaping we believe that such alignment is more important for coordination than mindreading inferences about mental states, and indeed that mindreading is instead a form of coordination behaviour that is dependent upon intuitive alignment.

Keywords: pure coordination games, alignment of intuitions, mindshaping, mindreading.

Introduction

Human social interaction often involves at least two people who must reach a "meeting-of-minds". This crucial insight was developed by the Nobel laureate Thomas Schelling (1960) to stress the importance of understanding the role of the interdependence of people's decisions, even in situations where interaction is asynchronous and no communication is possible (e.g., Colman, 1997, 2006; Gallotti & Frith, 2013; Larrouy, 2018; Sugden, 1995; Vesper et al., 2017). Individuals can intuitively concert their intentions with other people in a diverse range of cases with no communication involved, from instances in which two people need to pick the same positive number, to how some friends choose a meeting point if they end up separated at the conclusion of a crowded event. Research has tended to focus on the forms of thinking that could make such coordination possible and has tended to neglect how it is that people are ever in a position to coordinate on similar answers. Given that the space of possible answers can be arbitrarily large this is not a trivial problem, and it is one where we find the perspective offered by mindshaping to be enlightening. As psychologists we hope that psychology can make a useful contribution to understanding mindshaping by uncovering potentially relevant phenomena, considering how these relate to widely-studied psychological processes, and reflecting on how these case studies cast light on the much broader theory of mindshaping. The aim of this chapter is to describe what pure coordination games are and highlight a number of experimental findings conducted in our laboratory that extend the range of phenomena to be explained by demonstrating that coordination solutions are both variable and flexible. We will examine the potential for well-known psychological constructs – "theory of mind", common ground, interactive alignment – to account for these results, and we will consider what this might tell us about mindshaping.

Economics and Pure Coordination Games

Economics traditionally studies economic behaviour and its consequences based on a standard economic model. It is commonly assumed that individuals' decision making is individualistic and rational, is not limited by computational resources, and almost never make mistakes if rational decision-making reasoning is followed (Cartwright, 2018). Thomas Schelling (1960) questioned one of these key assumptions, highlighting that to understand people's decisions in social settings, we need to go beyond an individualistic point of view, and to accept that their decisions are interdependent even without interaction.

In pure coordination games, the positive outcome for all participants is achieved via coordination on the same response. Since each person stands to gain in the same way – there are no conflicts of interest – potential gains cannot be used as a criterion to decide on the best response. To coordinate participants must instead identify "focal points" – answers that somehow seem salient or obvious things to say or do in order to coordinate (e.g., Colman, 1997, 2006; Isoni, Poulsen, Sugden, & Tsutsui, 2013; Mehta, Starmer, & Sugden, 1994a; 1994b; Schelling, 1960; Sugden, 1995). To illustrate how focal points are involved in a variety of social situations, let us consider a particular well-known and canonical thought experiment known as the New York problem (Schelling, 1960). Imagine that two complete strangers need to coordinate a time and a meeting point in New York without communicating with one another. Despite the clear issue of not being able to explicitly agree a place and, hence, no rational solution being apparent for people, they indeed meet at noon at Grand Central Station, since they are presumed to share general and representative knowledge of New York locations, grounded on similar social and cultural experiences. Because of all of this, from a set of plausible options (e.g., the Statue of Liberty, Central Park, etc.), Grand Central Station is intuitively considered for both individuals the most salient place to meet in New York (e.g., Camerer & Fehr, 2004; Schelling, 1960; Sugden, 1995).

Much effort in the cognitive sciences has been put into understanding and describing the form of reasoning that supports successful coordination. (e.g., Bacharach, 2006; Camerer, 2003; Camerer, Ho, & Chong, 2004; Chater, Zeitoun, & Melkonyan, 2022; Colman, 1997; 2006; Colman & Gold, 2018; Mehta et al., 1994a; 1994b; Schelling, 1960; Sugden, 1995; Vesper et al., 2017). However, while an appropriate form of reasoning may be necessary for successful coordination, it is insufficient to explain how people home in upon a single response, or even a usefully small set of responses, that they would each give. While this challenge exists whenever two people seek to coordinate, we suspect that it has been underestimated because participants in studies of coordination tend to be culturally homogenous and from the same cultural group as the investigators.

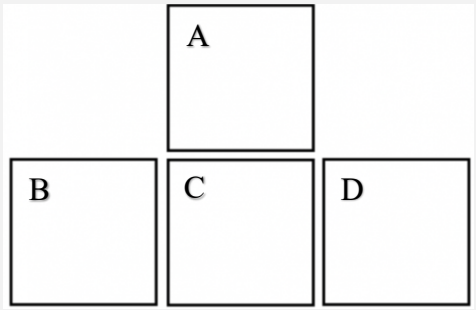
Empirical Evidence on Coordination Within and Between Groups

We have developed novel metrics and empirical coordination paradigms to examine how people use their intuitive judgments to coordinate with a range of groups and individuals. In this section, we will summarize experimental research that we conducted in nine independent studies (Perez-Zapata, 2023; Perez-Zapata, McKenzie-Smart, Charest & Apperly, under review; Perez-Zapata, Isoni, Zawidzki, & Apperly, under review; Perez-Zapata, Dunstone, Isoni, Zawidzki, & Apperly, in preparation) with 1,148 participants from various samples (e.g., children and adults, younger and older adults) from around the world (e.g., British, South African, and Chilean participants) and using different types of stimuli (e.g., verbal and visual tasks). We will present our empirical findings addressing five research questions: (1) whether a wide variety of people can successfully coordinate with one another; (2) whether different groups coordinate on different solutions; (3) whether people know how other groups coordinate; (4) whether people can coordinate between groups; and (5) whether coordination is based upon "new intuitions" that would not have been "obvious answers" outside of the coordination context.

Research Question 1. Can a wider variety of people successfully coordinate? Much research with pure coordination games has been conducted with relatively homogenous populations of young adults – often undergraduate students (e.g., Mehta et al., 1994a; Peryman & Kelsey, 2021). It cannot be taken for granted that coordination is also possible among more diverse groups. In our first empirical work with pure coordination scenarios, we carried out two studies with younger (i.e., four- to five-year-olds) and older children (i.e., six- to seven-year-olds) and we compared their coordination performance to adult participants (Perez-Zapata et al., under review). We built four coordination tasks (see the top two visual and verbal tasks of Table 1 for details). Previous work had shown that children in this age range are capable of coordination in principle – on highly constrained tasks designed to be as sensitive as possible to children's competence (Grueneisen, Wyman, & Tomasello, 2015). We tested how children (and adults) can apply their skills *in practice* when they must rely upon external knowledge and experience to find what might be salient or obvious from the coordination paradigms. Our results revealed that even children of five years of age coordinated successfully with each other across on 3 of the 4 tasks, though less successfully than adults. These findings have been replicated in all of our studies, including a further group of children and multiple groups of adults of different ages and nationalities.

Table 1. Item examples for each of the five tasks used in Perez-Zapata et al (under review) and Perez-Zapata et al (in preparation). Numerical values correspond to the proportion of participants selecting each response option for each group. It can be observed that some responses were preferred over others, and that the pattern of preferences sometimes varied between groups.

Coarse Visual Item



	4- to 5-year-olds	6- to 7-year-olds	Adults
A	.00	.06	.73
B	.04	.13	.04
C	.79	.62	.04
D	.04	.06	.04

Fine Visual Item

	4- to 5-year-olds	6- to 7-year-olds	Adults
A	.12	.13	.25
B	.25	.10	.16
C	.12	.50	.46
D	.33	.13	.00

Forced-choice Verbal Item

In a garden, you would find a:
Bird
Fence
Tree
Ball

	4- to 5-year-olds	6- to 7-year-olds	Adults
Bird	.16	.40	.04
Fence	.24	.03	.38
Tree	.36	.33	.46
Ball	.08	.10	.00

Open-ended Verbal Item

Name a Shape:

	4- to 5-year-olds	6- to 7-year-olds	Adults
Square	.38	.17	.38
Triangle	.25	.17	.38
Circle	.17	.06	.08
Sphere	.00	.13	.00

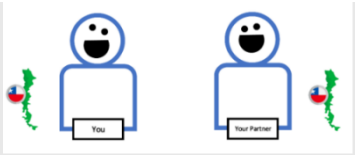
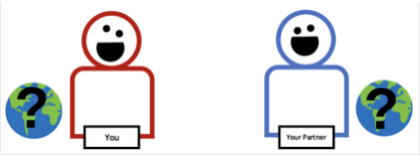
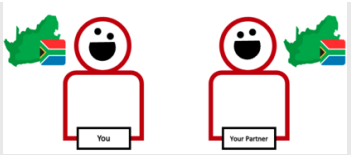
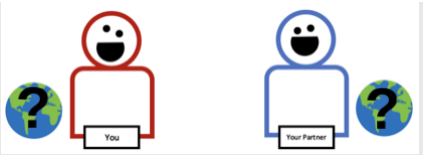
Open-ended Verbal Item: Name a city

Chilean Participants

Chilean partner [Within condition]	Unknown nationality partner [Between condition]

South African Participants

South African partner [Within condition]	Unknown nationality partner [Between condition]

				
Précis of instructions Responses	Type a suggestion that you think other Chilean will also suggest.	Type a suggestion that you think a person from around the world will also suggest.	Type a suggestion that you think other South African will also suggest	Type a suggestion that you think a person from around the world will also suggest
Santiago	.94	.04	0	0
Concepcion	.01	0	0	0
Cape Town	0	0	.42	.01
Johannesburg	0	0	.37	.06
New York	0	.52	0	.64
Paris	0	.06	0	.08

Research Question 2. Do different groups coordinate on different solutions? From Table 2 it appears that different age groups often coordinated on different solutions. For example, on the sample item we have given from the "Coarse visual task" (top left panel) children tended to coordinate on response "C", while adults tended to coordinate on response "A". Likewise, in the example item from the "Forced-choice verbal task" (middle left panel), when participants were asked "In a garden, you would find a …" older children mostly said "bird", instead adults responded "tree". To quantify these differences, we tested whether participants' likelihood of coordination with others was greater when the "others" were people in their own group or another group (e.g., 5-year-olds versus adults). These analyses have consistently shown that different age groups and different national groups show a tendency to coordinate on different answers. Later we will consider the potential reasons for such differences. For current purposes, we highlight the fact that such variation potentially poses a significant challenge if participants wish to coordinate with someone from another group.

Research Question 3. Do people know how other groups coordinate? In one of the studies conducted in our lab, we recruited participants from the UK plus a diverse "Global" sample from 30 other countries, including participants from each continent (Perez-Zapata et al., under review). In one condition participants sought to coordinate within their UK or Global groups. In another condition the UK and Global participants were asked to anticipate the coordination solutions of the opposite group. We found that each group could successfully predict what the other group would say, over and above any similarities that happened to exist between coordination solutions within each group. This finding supports the idea that the "obvious" answers for coordination depend upon group membership, and notably, that people have some ability to anticipate solutions from different groups.

Research Question 4. Can people coordinate between groups? In one of our studies, we recruited two hundred participants in total from Chile and South Africa. We administered coordination problems under two conditions: coordinating with a partner from their own country group, and coordinating with a partner who could be from any part of the world. As illustrated in the first and third columns in the bottom panel of Table 2, most Chileans coordinated among themselves on a very focussed set of answers relevant to Chileans. South Africans showed an analogous pattern. Consequently, while they succeeded in their given task of coordinating among themselves, the two groups' answers were highly divergent from one another. Nonetheless, when tasked to coordinate with a partner from another country we found that Chileans and South Africans provided very similar responses to one another (as illustrated in the second and fourth columns of Table 2). This pattern of results strongly suggests that participants were able to shift intuitive responses depending on whether they were seeking to coordinate with someone from their own country or someone from another country. We replicated the same findings in another study with participants from South Africa and the UK (Perez-Zapata et al., under review).

Additional converging evidence was observed in another independent two-study project involving younger and older British adults, which used a larger set of open-ended coordination questions (Perez-Zapata et al., in preparation). This body of findings indicates that people are not only aware of differences in their intuitions when coordinating with people from different generations, but also successful in adapting their judgments in the right direction to coordinate with one another.

Research Question 5. Is coordination based upon new intuitions? This research question brings us face-to-face with one of Schelling's seminal insights on how our coordination solutions are not simply based upon answers that seem obvious to oneself, but rather answers that become obvious just in the context of coordination. Despite the centrality

of this claim for Schelling's account, empirical evidence is surprisingly thin. For example, Mehta et al.'s (1994a) seminal paper systematically applied Schelling's foundational ideas by presenting university students with 20 verbal and non-verbal prompts, such as naming a colour or any positive number. Their findings showed that participants frequently converged on a small set of obvious answers. For example, when asked to coordinate on any positive number, 40% of participants chose "1", and 78% selected either "1", "7", "10", or "2". Critically, this would provide evidence of "new intuitions" if the pattern of responses was specific to the problem of coordination. Such evidence was found in this problem, because when other participants were asked to think of a number without coordinating, "1" was only the fourth most common answer, while "7" was the most frequent. However, this was only true for 4 out of the twenty problems studied by Mehta et al.

It is particularly challenging to seek clearer evidence when testing coordination solutions within the relatively homogenous group of participants used in most previous studies. This is because participants from a homogenous group are quite likely to have at least somewhat similar ideas about the obvious answers to test questions even when they are not trying to coordinate, leaving limited opportunity to observe truly novel coordination solutions. Our between-group coordination studies provide a much better opportunity to observe such differences.

To illustrate our results, we would like to use again the study with Chilean and South African participants detailed in the bottom panel of Table 2. For the item "name a city", responses in the within conditions clearly reflect the salient focal points for Chileans (i.e., "Santiago") and South Africans (i.e., "Cape Town" and "Johannesburg"). However, as mentioned above, both national groups coordinated on solutions such as "New York" or "Paris" when they were coordinating with a partner from anywhere, which were not

suggested whatsoever in the same country coordination condition. This pattern of completely new intuitions was observed in 14 out of 15 alignment items.

In summary, our findings reveal that a variety of people are very adept at solving pure coordination challenges with a range of stimulus types. Different groups often coordinate on different solutions, but people are aware of this, and they can flexibly adapt their responses to coordinate with partners from other groups. Additionally, even in circumstances where there is no specific information about the partner, people demonstrate resilience in coordinating with one another around novel focal points, as suggested by Schelling's canonical ideas.

Formal Accounts are Insufficient to Explain Coordination.

A key insight from Schelling is that pure coordination games – in which payoffs are equal for all solutions provided that the people coordinate - defy resolution through the conventional analytic framework of game theory, where each person calculates their optimal response to others' optimal responses. Successfully solving a pure coordination game hinges essentially on the relationship between the two people's behaviours: my decision to go to Grand Central at midday is only the optimal response if it aligns with yours, and vice versa. This relational structure is not tractable to purely individual decision-making, leaving both of us without a compelling reason to select this particular location and time (e.g., Colman & Gold, 2018). Formal accounts of pure coordination games have sought to identify tractable alternatives, such as "team reasoning" (e.g., Bacharach, 2006; Bardsley, Mehta, Starmer, & Sugden, 2010; Bardsley & Ule, 2017; Colman & Gold, 2018) and "virtual bargaining" (e.g., Chater et al., 2022: Misyak et al., 2014). These address the essentially "joint" nature of decisions but cannot themselves explain how participants engaged in such a decision come to decide upon the same response. For this reason, theorists have appealed to the notion of "salience" (Mehta et al., 1994; Colman & Gold, 2018). The joint context of coordination decisions conditions the salience of possible responses, and participants select the most

salient response given this context. However, invoking salience merely defers the puzzle, because in and of itself it fails to explain how people engaged in the appropriate reasoning are in a position to find the same response maximally salient. This challenge is only made worse by the evidence presented above showing that people from different groups often alight on different solutions when coordinating within-group, and that people can nevertheless coordinate between-group. Might a solution to this puzzle exist in relevant work in psychology?

What Additional Psychological Processes Enable Coordination? Mindreading, Common Ground, Interactive and Intuitive Alignment

*Mindreading***.** A common intuition is that solving coordination problems naturally involves taking the perspective of one's coordination partner, and is therefore a species of "mindreading" (or theory of mind, or mentalizing). Mindreading might be defined as a multi-faceted socio-cognitive ability to understand, make sense and predict people's behaviour based on abstract mental states such as thoughts, intentions or beliefs (e.g., Apperly, 2010; Wellman, 2014). However, careful consideration of the challenge of coordination complicates this intuition to the point where many researchers consider mindreading – at least as traditionally conceived - to be an intractable solution. The basic intuition is that Partner 1 in a coordination game should first take the perspective of Partner 2 to figure out what they would say or do, and then say or do the same thing themselves in order to coordinate successfully. The problem – as identified by Schelling and others (e.g., Chater et al., 2022; Gallotti & Frith, 2013; Schelling, 1960; Mehta et al., 1994a; 1994b; Misyak et al., 2014; Sugden, 1995; Wilson, Hruby, Perez-Zapata, van der Kleij, & Apperly, 2023; Zawidzki, 2013; 2018) – is that when Partner 1 takes the perspective of Partner 2 they ought to recognise that Partner 2 will themselves be taking the perspective of Partner 1, and moreover they should recognise that Partner 2 should recognise that Partner 1 will be taking their

perspective. For pure coordination games there is no way out of this infinite regress of partners second-guessing one another, other than with ad hoc assumptions, for example that the partner will have the same intuitions as oneself (e.g., Colman & Gold, 2018), at which point it is unclear whether mindreading is necessary at all. We will suggest below that rather than mindreading being part of the solution for pure coordination games, the alignment of intuitions that is an inherent feature of successful coordination makes accurate mindreading possible.

Common ground. The role of common ground in coordination has been highlighted in previous research (e.g., Clark, 1996; De Freitas, Thomas, DeScioli, & Pinker, 2019). Many instances of coordination are shaped by the presumed mutual knowledge shared between individuals (Clark, 1996). Clark (1996) has classified common ground in two general types: personal common ground and communal or community common ground. The former encompasses joint personal and perceptual experiences, and the latter uses evidence of the community a certain person belongs to as a basis to infer common knowledge and experience. People can classify others based on a variety of social categories such as religious belief, cultural membership, nationality, profession, occupation, political affiliation, ethnicity, among others. These social labels are important for people because they shape their minds and they can use them to infer what others can know and believe. For example, when two previously unknown people meet and find they both have a common interest in rock music, the range of possible topics of conversation suddenly expands and can establish a common ground based on rock music knowledge. They do not need to live in the same city or even in the same country to be members of a given community. What is necessary is that they recognize themselves as members of the community of rock music fans, to set common ground and take for granted a large body of rock music knowledge. Therefore, successful

coordination might be directly related to how individuals identify a shared basis, grounded on community common ground.

Consideration of common ground may help people identify a set of responses on which coordination is possible in principle. However, coordination in practice requires participants to identify a single best response, and in most circumstances consideration of common ground alone provides no basis for this selection. This is because the common ground processes described above deal only in generalities about what may or may not be in common between partners. In communication these generalities are iteratively refined into what is in common for current purposes through the interaction of communicators. Critically, such iterative refinement is not possible in pure coordination games, because they preclude interaction and communication. Thus, common ground is clearly insufficient to explain success at pure coordination.

Interactive alignment. Other research in psycholinguistics has investigated in detail the iterative processes by which interacting communicators refine their representations and provides inspiration for how coordination might be possible without interaction or communication. During a dialogue, speakers gradually align their syntax, word selection, meaning representations and phonology (e.g., Garrod & Pickering, 2004; Pickering & Garrod, 2004, 2021). Fluent discourse is temporarily facilitated to the extent that communicators' representations become aligned. Such ideas and evidence of course accord well with the idea of mindshaping via "imitation" (Zawidzki, 2013). This body of research has primarily examined temporary alignments, which are necessarily revised when shifting to a new conversation. Yet, it is plausible that undergoing repeated temporary alignments could also influence people's long-term intuitions of what seems mutually salient or intuitively obvious within a particular context. Based on this modest extension of findings from psycholinguistics research, we next develop the idea of intuitive alignment.

Intuitive alignment. We propose the idea of intuitive alignment as the ability to select a plausible and socially coordinated response from a range of options, based on salient features of the time, places and partners involved. Such intuitive models enable coordination on focal points in the absence of logically right or wrong answers. Like the interactive alignment account described above, intuitive alignment entails shared representation among individuals, allowing them to pick the same focal points of common ground to understand and judge real-time and asynchronous social interactions. However, unlike interactive alignment, intuitive alignment does not require interaction and communication between the coordinating parties. Instead, it depends upon a prior history of such interaction with relevantly similar people. Reliance upon shared history (rather than logic) readily explains why different groups often coordinate upon different answers (as shown in research question 1) – because they will have different shared histories of interactive alignment that result in different focal points being salient answers to the same questions. The fact that people are also able to coordinate between groups with different histories (and therefore different within-group focal points) shows that these intuitive responses are flexible, and can be conditioned effectively to accommodate the nature of the group that is attempting to coordinate. We predict that people with experience of interacting with a more diverse range of people will be better able to make such accommodations.

Mindshaping, Coordination, and Mindreading

In *Mindshaping*, Zawidzki (2013) discusses a range of coordination phenomena, and accords coordination abilities (and plural subject reasoning more generally) primacy over mindreading in explanations of human social cognition. One of us has made a related argument that mindreading is just one among many abilities supporting social cognition (see Apperly, 2010). We believe the findings described here make a distinctive additional

contribution both to understanding the relationship between coordination and mindshaping, and how each is related to mindreading.

We believe that pure coordination games are an informative case study of mindshaping. One central idea in *Mindshaping* (Zawidzki, 2013) is that humans' ability to make sense of one another depends on the interlocking products of social experience. On the one hand, social experience provides the evidence base for person 1 to make contextually sensitive predictions and interpretations about the behaviour of person 2. On the other hand, social experience provides a set of expectations and obligations about how person 2 should behave, which underwrites the validity of person 1's predictions and interpretations about them. Of course, person 1 and person 2 are interchangeable, and the situation is extendable to groups and populations. The present evidence on pure coordination games highlights that such interdependent processes need to extend to a very fine level of granularity. For example, adults' ability to coordinate with high frequency on either "square" or "triangle" when naming a shape (see Table 1) cannot be based upon a normative principle (squares and triangles are not inherently or conventionally better, or more valuable than other shapes), nor on an assumption of common knowledge, since many other shapes should also be mutually known. Instead this success must be based upon the highly specific aligned intuition that these are the two "obvious" answers on which coordination is likely in this instance. Moreover, research on interactive alignment provides a candidate mechanism by which the experience of interactive coordination provides the experiential basis for such fine-grained intuitions to exist, and to be valid for coordination without interaction.

A key motivation in *Mindshaping* is that mindreading (or "mentalizing", or "theory of mind") is inadequate to explain social abilities. Zawidzki offers several arguments for why, but the most important for current purposes is that inferences about mental states are often severely underdetermined by the available information about the person or context (see

Apperly, 2010, for a related argument about why mindreading should be impossible). Zawidzki also argues that mindshaping is part of the solution to this challenge. That is to say, when person 1 wants to predict or interpret what person 2 thinks or feels, it is the interlocking products of social experience that underwrite the validity of these inferences. Again, we believe the potential contribution of the present findings is to add the fine granularity that would be necessary for this to work. Shared social experience leads people to have usefully aligned intuitions about what it is relevant and appropriate to think or feel in a particular situation, and it is these aligned intuitions which ensure that mindreading inferences are not hopelessly underdetermined.

Conclusion

Alignment of intuitions enables individuals to successfully solve coordination scenarios by bringing together forms of reasoning and allowing them to find or choose the same piece of common ground with others, even in situations where no communication is possible, or where interaction is asynchronous. Our findings provide evidence that coordination decisions *vary* between different populations and are *flexible* when thinking about or coordinating with different groups, resulting in *accurate* adaptations to variability between populations. People have different models of intuitions and use them differentially according to whom they are coordinating with. Intuitive models might play a central role in social understanding in various situations and could be a fruitful line of research in the coming years.

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