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Intimate imitation: Automatic motor imitation in romantic relationships

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ABSTRACT

Our relationships with romantic partners are often some of the closest and most important relationships that we experience in our adult lives. Interpersonal closeness in romantic relationships is characterised by an increased overlap between cognitive representations of oneself and one's partner. Importantly, this type of self-other overlap also occurs in the bodily domain, whereby we can represent another's embodied experiences in the same way as we represent our own. However, as yet this bodily self-other overlap has only been investigated in individuals unfamiliar to each other. Here, we investigate bodily self-other overlap between romantic partners, using automatic imitation as an example case of bodily overlap in the motor domain. We found that participants automatically imitated romantic partners significantly more than close others with whom they had a platonic relationship. Furthermore, imitation in these relationships was related to key aspects of relationship quality, as indicated by adult attachment style.

1. Introduction

Our social lives revolve around the formation and maintenance of relationships with others. These relationships can be close and intimate, such as that between romantic partners, or they can be more distant, such as that between casual acquaintances or work colleagues. Therefore, the nature of each individual relationship can be characterised by the perceived distance between the self and the other. It is this distance between self and other that plays an important role in how we feel about an individual and how we behave towards that individual in social situations (Aron, Mashek, & Aron, 2004; Myers & Hodges, 2012). Importantly, in relationships that are very close, we act as if characteristics of the other individual are partially our own (Wright, Aron, & Tropp, 2002), reflecting an overlap between cognitive representations of self and close others (Aron, Aron, Tudor, & Nelson, 1991). This overlap leads to a diminished self/other distinction (Aron et al., 2004), and is positively correlated with feelings of love, commitment and intimacy (Agnew, Van Lange, Rusbult, & Langston, 1998).

Self-other overlap with one's romantic partner is also related to the quality of the relationship as defined by adult attachment theory (see Brennan, Clark, & Shaver, 1998). Just as with infants, adult attachment can be decomposed into two latent dimensions, termed anxiety and avoidance. The anxious subscale assesses feelings of anxiety regarding abandonment, and the motivational desire for closeness. The avoidant subscale, in contrast, assesses partners' desire for autonomy and fear of intimacy (Brennan et al., 1998; Fraley, Waller, & Brennan, 2000). These two attachment styles represent working models of the self and of the other (Griffin & Bartholomew, 1994), with anxious attachment associated with a negative appraisal of the self, and avoidant attachment associated with negative appraisal of the other. Consistent with this, self-other overlap in the cognitive domain has been found to directly relate to attachment style (Mikulincer, Orbach, & Iavnieli, 1998), usually with anxious attachment predicting the desire for increased self-other overlap, and avoidant attachment predicting a desire for increased self-other distinction (e.g. Slotter & Gardner, 2012).

This cognitive overlap between self- and other-representations is a key focus in the study of personal relationships. However, overlap also exists in our representations of embodied experiences (Gallese & Sinigaglia, 2011). In these cases, when we observe the embodied experience of another person, we partially share that experience ourselves. For example, we wince when we see someone else in pain (Lamm, Porges, Cacioppo, & Decety, 2008), and when we observe another person moving, we often automatically imitate their actions (e.g. Chartrand & Bargh, 1999). This embodied self-other overlap can also be observed at the neural level, in 'mirror-like' brain regions that show vicarious activity to others' pain, tactile experiences and movements (see Keysers & Gazzola, 2009).

The overlap between embodied self- and other-representations appears in some ways analogous to the overlap between more conceptual self-other representations referred to by social

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psychologists in the study of relationships. Therefore, social closeness between people may be reflected not only in the overlap in the conceptual domain (e.g. Pipp, Shaver, Jennings, Lamborn, & Fischer, 1985), but also in the bodily domain. It is surprising, however, that despite the recent emphasis on a second-person social neuroscience approach (Schilbach et al., 2013), the majority of the studies investigating the roles of bodily overlap have used individuals who are unfamiliar to each other. This is despite there being clear evidence for a relationship between positive social appraisal and bodily overlap. For example, bodily overlap is increased in the motor and sensory domains when positive attitudes are elicited towards an unfamiliar individual (e.g. Wang & Hamilton, 2012), and vice versa, when bodily overlap is experimentally elicited with an unfamiliar individual, there is an increase in liking, trust and attraction towards them (for review, see Maister & Tsakiris, 2015). Together, these results lend indirect support to the hypothesis that bodily overlap may be enhanced between individuals in romantic relationships. However, as far as we know, no direct investigation of bodily self-other overlap between romantic partners has yet been performed.

In the current study, we hypothesize that bodily overlap may be a special feature of close personal relationships, just like more conceptual forms of self-other overlap. We make two empirical predictions. First, we expect that the level of bodily overlap between self and other will be higher in romantic relationships than other, less intimate relationships. Second, given that social attitudes have a top-down modulatory effect on bodily overlap (e.g. Wang & Hamilton, 2012), we would predict that bodily overlap within romantic relationships will be influenced by adult attachment style, in a similar way to more cognitive forms of overlap (Slotter & Gardner, 2012).

To test these two hypotheses, we investigate one example of bodily overlap, automatic imitation, between individuals in romantic relationships. Automatic imitation is an important and prevalent example of shared body representations in everyday interactions, as it reflects a special matching between perception of another person's actions and the performance of one's own actions (Iacoboni et al., 1999). It also has a fascinating relationship with more affective aspects of social cognition; for example, we imitate individuals more if we hold positive social attitudes towards them, and being imitated increases our liking and trust of the individual imitating us. Furthermore, imitation can be unconsciously employed to achieve affiliation goals, such as when we have a desire for increased interpersonal closeness with another (Van Baaren, Janssen, Chartrand, & Dijksterhuis, 2009, for review).

Hitherto, the research into embodied processing within romantic relationships has been primarily restricted to emotional co-regulation (e.g. Butner, Diamond, & Hicks, 2007), entrainment of physiological states (e.g. cortisol levels, Saxbe & Repetti, 2010), or action understanding (Ortigue, Patel, Bianchi-Demicheli, & Grafton, 2010). So far, there has been no research investigating 'pure' motor imitation between partners, despite its clear importance to sociocognitive processing. The small number of studies that have focussed on motor imitation have not looked at the imitation of partners, but instead focussed on the interaction between relationship status and the imitation of strangers (e.g. Karremans & Verwijmeren, 2008). Therefore, the extent to which we imitate romantic partners, and what functions imitation serves within romantic relationships, are still unknown.

Here, we directly investigated the extent to which individuals automatically imitate their romantic partners, in comparison to platonic friends of the same gender as the partner, using a well-controlled stimulus-response compatibility paradigm to provide a precise measure of automatic imitation for both relationship types. We also measured participants' attachment style to both their partner and friend to investigate how imitation may be differentially influenced by relationship-specific attachment anxiety or avoidance.

2. Material and methods

2.1. Subjects

Twenty-one participants (11 females, M(age) = 20.4 years, 95% CI[19.8,21.0]) were recruited via online advertisements from the undergraduate student community. Of these, 17 self-identified as White, 1 as Asian/Asian British, 1 as Mixed/Multiple Ethnic Groups, and 2 as of Other ethnic group. Participants were required to have been in a committed and exclusive romantic relationship for >6 months at the time of the study, and to nominate a close friend, of the same gender as their partner, who they had been in a platonic friendship with for roughly the same length of time ($M_{PARTNER}$ = 12.5 months, 95% CI[9.9,15.2]; M_{FRIEND} = 15.4, 95% CI [11.7,19.2], $t(19) = 1.85$, $p = 0.080$). All participants who volunteered were heterosexual.

2.2. Tasks

2.2.1. Attachment questionnaire

The 'Relationship Structures Questionnaire of the Experiences in Close Relationships-Revised (ECR-RS)' (Fraley, Heffernan, Vicary, & Brumbaugh, 2011) provides two scores, reflecting attachment anxiety and attachment avoidance. Participants completed the questionnaire items twice, in a random order; once referring to their partner, and once to their named friend.

2.2.2. Imitation task

To assess imitation, we used a standard stimulus-response compatibility paradigm (Brass, Bekkering, Wohlschläger, & Prinz, 2000). In this widely-used paradigm, participants are required to perform a simple action, whilst watching another person performing either the same action (a 'congruent' trial) or the opposite action (an 'incongruent' trial). Observing another person performing an action can strongly influence one's own movement execution, as both motor execution and observation activate a common motor representation (see Iacoboni et al., 1999). Reaction times are typically slower on incongruent trials as compared to congruent trials, because in this case the activated motor representation conflicts with execution of the required action. This difference in reaction times between incongruent and congruent trials is taken as an index of automatic imitation.

Here, participants performed a variant of this paradigm, following that of Leighton and Heyes (2010). Trials began with a warning stimulus, showing the partner or friend's face in a 'neutral' (lips relaxed and parted) mouth position. Participants were instructed to adopt this same position at the start of each trial. The partner/friend then performed either a single mouth-opening or mouth-closing action (the task-irrelevant movement stimulus). At the same moment, a signal (the 'imperative' stimulus, taking the form of a green or red dot) appeared in the mouth region, in response to which participants made their own mouth-opening or mouth-closing movement as quickly as possible (see Fig. 1).

The required movement was either congruent or incongruent with the movement they observed their partner or friend perform. Reaction times were measured using facial electromyography (EMG). The task had a simple 2×2 design, with the relationship with the featured face (romantic vs. platonic) and the congruence between the required and observed actions (congruent vs. incongruent) as within-subject factors. Participants completed 128 experimental trials, the order of which were randomised.

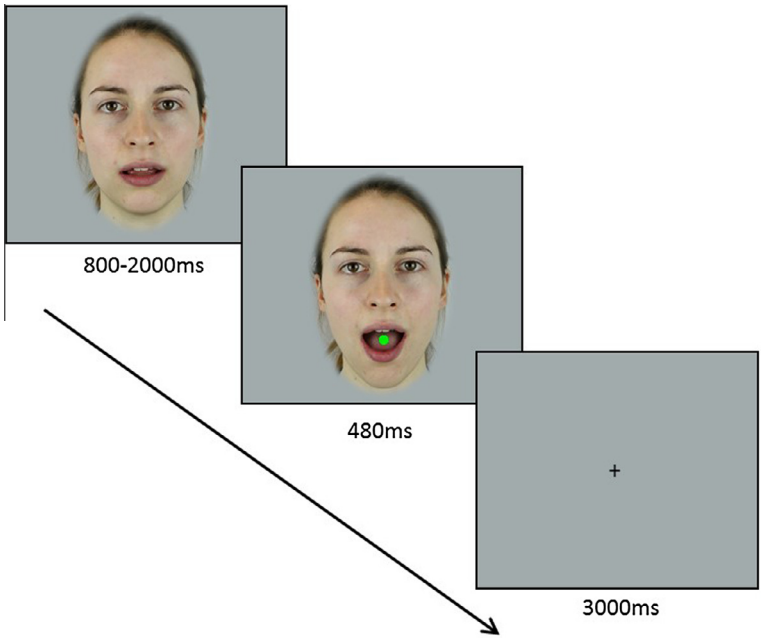

Fig. 1. Diagram illustrating the structure of an example trial. Participants were required to respond to a green- or red-coloured dot with either a mouth-opening or mouth-closing movement, as fast as possible. Each trial featured either the face of their partner, or of their friend. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Images of the partner and friend used in the task were obtained in a separate recording session carried out prior to the main experiment. Each individual was trained to form controlled neutral, mouth-closed and mouth-open positions with teeth hidden and specific lip apertures (for neutral positions, 1 cm distance between lips, and for mouth-open positions, 4 cm between lips). Only images with the correct mouth aperture, direct gaze and a neutral expression were chosen to be used as final stimuli.

2.3. Procedure

To prepare for EMG recording, two 4 mm Ag-AgCl electrodes were placed on the Orbicularis Oris on the left hand side of the mouth, and a ground electrode placed on the right side of the forehead, following guidelines developed by Fridlund and Cacioppo (1986). Participants then completed the two attachment questionnaires, before completing the Imitation task.

3. Data recording and analysis

The EMG signal recorded from the Orbicularis Oris was amplified, mains-hum filtered at 50 Hz, high-pass filtered at 20 Hz and rectified. Reaction times were defined as the time between the imperative stimulus, and the onset of the participant's correct movement. Movement onsets were defined as the point at which a rolling average of the EMG signal, calculated across a 20 ms epoch, exceeded 2.5 times the standard deviation of the 500 ms rest period before the appearance of the imperative stimulus (see Leighton & Heyes, 2010 for details). Reaction times were excluded from further analysis if they exceeded ±2 standard deviations from each individual's mean RT for each trial type. The resulting distributions of RT scores for each trial type did not deviate from normality as tested using the Shapiro-Wilk Test for Normality (all p-values > 0.131).

4. Results

First, scores reflecting attachment-related anxiety (ANX) and avoidance (AVO) were extracted for both the romantic and the platonic relationship, for each participant (following Fraley et al., 2000). Two participants were excluded for having scores >±2SD from the group mean, leaving 19 participants for final analysis. Mean ANX scores did not significantly differ between relationship types, M(romantic) = 1.75, 95% CI[1.14,2.36], M(platonic) = 1.95 95% CI[1.41,2.48], $t(18) = 0.64$, $p > 0.250$. However there was a significant difference in AVO scores, M(romantic) = 1.20, 95% CI [0.75,1.65], M(platonic) = 3.11, 95% CI[2.33,3.90], $t(18) = 5.28$, $p < 0.001$, $d = 1.44$. There were no gender differences in any of the attachment scores (all p-values > 0.11).

To obtain a broad understanding of automatic imitation of partners and friends before attachment was considered, we first carried out a basic repeated-measures ANOVA with two within-subjects factors, Congruency (congruent vs. incongruent) and Relationship (platonic vs. romantic). This revealed an expected large main effect of Congruency, $F(1,18) = 91.8$, $p < 0.001$, whereby participants were significantly faster to respond to congruent trials, M = 390 ms, 95% CI[333,447], than incongruent trials, M = 465 ms, 95% CI[402,529]. Importantly, this effect was significantly moderated by Relationship, $F(1,18) = 14.96$, $p = 0.001$. Paired t-tests revealed that participants were faster to respond to their partner than their friend on congruent trials, $M_{PARTNER}$ = 378 - ms, M_{FRIEND} = 400 ms, $t(18) = 2.70$, $p = 0.015$, and slower to respond to their partner compared to their friend on incongruent trials, $M_{PARTNER}$ = 476 ms, M_{FRIEND} = 454 ms, $t(18) = 1.89$, $p = 0.075$. The absolute difference in RT between trials featuring the partner and the friend did not significantly differ for congruent vs. incongruent conditions, M_{CONG} = 34.3 ms, M_{INCONG} = 38.1 ms, $t(18) = 0.36$, $p = 0.725$. This suggested that the effects of Relationship were observed relatively equally in both congruent and incongruent trials.

Next, adult attachment scores were added to the analyses to investigate how these were related to automatic imitation. As each participant had four separate scores indicating their attachment to their partner and to their friend, a linear mixed effects model was deemed a suitable alternative to standard repeated-measures ANCOVA as it allows for covariates that differ for different levels of the repeated factor. The dependent variable was the congruency effect (CE), calculated by subtracting the mean RT for incongruent

trials from those for congruent trials, for 'partner' and 'friend' separately. Using GENLINMIXED in SPSS 21, a fully-factorial model was fitted with one within-subjects categorical predictor, Relationship (platonic vs. romantic), and two standardised continuous between-subjects predictors, ANX and AVO. A random factor, representing the intercept for each participant, was also entered, to take into account the within-subjects nature of the data.

This model was a significant fit for the data, $F(7,30) = 19.25$, $p < 0.001$. Inspection of the model parameters revealed a main effect of Relationship, $F(1,30) = 4.40$, $p = 0.044$, whereby individuals showed significantly greater mimicry of their partners than they did their friends, controlling for differences in ANX and AVO attachment style (see Fig. 2).

This effect was significantly moderated by ANX, $F(1,30) = 9.25$, $p = 0.005$, whereby ANX had a significantly different effect on mimicry of partners compared to friends. For the partner, the parameter estimate of the effect of ANX on mimicry was positive, $M = 19$ ms, 95% $CI[-1,40]$, $p = 0.064$, and for the friend was negative, $M = -15$ ms, 95% $CI[-26,-4]$, $p = 0.012$. In contrast, there was no significant main effect of AVO attachment style, $F(1,30) = 0.57$, $p = 0.456$, nor did it interact with Relationship, $F(1,30) = 0.51$, $p = 0.479$. These findings are summarised in Fig. 3.

To investigate whether the level of anxious attachment in the romantic relationship affected levels of automatic imitation in the platonic relationship, and vice versa, we repeated the main analysis but entered anxious attachment scores within the *other* relationship in place of our standard ANX measure. This revealed no main effect of cross-relationship ANX, $F(1,34) = 1.48$, $p = 0.233$, nor an interaction between relationship type and ANX, $F(1,34) = 1.17$, $p > 0.250$. These results suggest that only the anxious attachment style within a specific relationship predicted automatic imitation within that relationship.

5. Discussion

We investigated the sharing of bodily experiences, or 'self-other bodily overlap', between romantic partners and platonic friends. Using automatic motor imitation as an example case of bodily self-other overlap (Brass & Heyes, 2005), we investigated first whether romantic relationships were characterised by enhanced self-other overlap, and second whether this would be influenced by adult attachment style. Participants imitated romantic partners significantly more than close opposite-gender friends, despite the romantic and platonic relationships being of relatively equal lengths. These findings extend existing research showing an enhanced overlap of *conceptual* representations within romantic relationships (Aron et al., 2004), and might also provide the mechanism by which action understanding is enhanced between romantic partners (Ortigue et al., 2010).

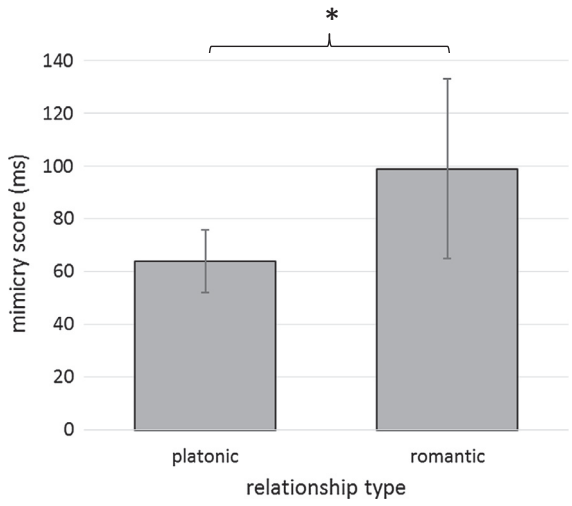

Fig. 2. Graph showing mean levels of automatic imitation for both the romantic and platonic relationships, when effects of anxious and avoidant attachment are statistically controlled for (held at their respective sample means). Asterisk indicates significant difference between relationships, $p < 0.05$. Error bars indicate 95% confidence intervals.

Importantly, attachment style, in particular an anxious attachment pattern, played a significant role in determining the extent to which participants imitated their partners and friends. Anxious attachment style was related to imitation within romantic and platonic relationships in opposing ways; it had a positive relationship with imitation within the romantic relationship, as the more anxious the quality of attachment, the more the romantic partner was imitated, whilst it had a negative influence on imitation within the platonic relationship, as the more anxious the attachment to the friend, the *less* the friend was imitated. Interestingly, the attachment quality of the participants' romantic relationships did not influence the extent to which they imitated their opposite-sex friends, or vice versa. Thus, the effect of attachment quality on imitation was specific to each relationship considered.

Anxious attachment style is characterised by fears of abandonment, which drive a desire for increased interpersonal closeness. It is also linked to a working model of negative self-worth in relation to the partner (Griffin & Bartholomew, 1994). In the conceptual domain, attachment anxiety is related to increased overlap in cognitive representation of self and other (Slotter & Gardner, 2012). We show that this may also be the case for *bodily* self-other overlap, as a desire for increased closeness with the partner resulted in a greater sharing of the other's motor experiences, despite this being detrimental to task performance. Given the known prosocial effects of being imitated on our perception of the person imitating us (Bailenson & Yee, 2005), increased imitation of the partner may indeed be a successful strategy to increase their affiliation and closeness.

However, it is less clear why anxious attachment in the platonic relationship, as measured using the same questionnaire and thus measuring similar subjective attitudes (Fraley et al., 2011) would have the opposite effect on bodily self-other overlap. However, it is likely that the romantic partner, rather than the friend, was the primary attachment figure for the majority of our participants. Because of this, there may have been less emotional investment in the relationship with the friend as compared to the partner. Importantly, being in the presence of an individual to whom one is anxiously attached elicits distressing feelings, characterised by an intense fear of abandonment (Fuendeling, 1998). Therefore, anxiously-attached participants may have rejected embodied self-other overlap with the friend to distance themselves from the source of their distress. For the partner, in contrast, the heavily-invested nature of the relationship meant that every attempt was made to increase closeness, regardless of the distress experienced, and so automatic imitation was enhanced.

Social desirability may also play a role in our results. Evidence suggests that when individuals experience anxiety, fear of abandonment and jealousy in their relationship with their platonic, opposite-sex friend, they often perceive it as inappropriate, especially when one or both individuals are in romantic relationships. This anxiety induced feelings of shame and emotional withdrawal from the platonic relationship (Aune & Comstock, 1997). Therefore, the reduction in motor imitation of the friend observed in anxious individuals may reflect a top-down control mechanism driven by a desire to suppress an inappropriate emotional response. Further research is required to test these potential explanations.

Regardless of the specific mechanism underlying this finding, our results demonstrate that equivalent attachment styles within

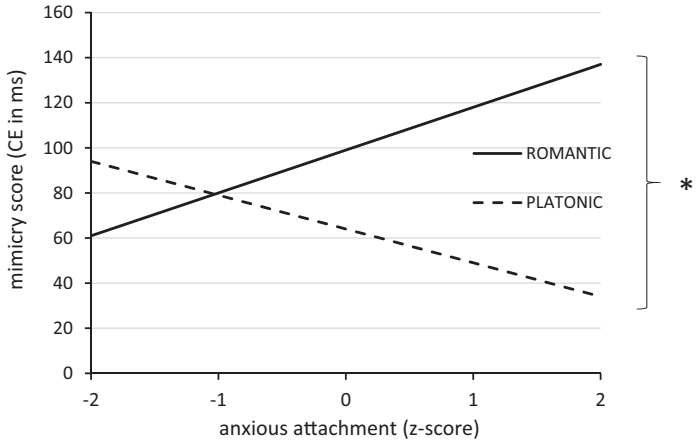

Fig. 3. Graph showing the relationship between anxious attachment style and automatic imitation, for both the romantic and platonic relationships. Asterisk indicates significant difference between slopes for romantic and platonic fitted regression lines, $p < 0.05$.

different types of adult relationship, as assessed by a widely-used questionnaire measure that assesses similar emotional and motivational aspects in both cases (Fraley et al., 2011), may result in distinct outcomes at a behavioural level. Despite attachment styles for the romantic and platonic relationships moderately correlating in our sample and in other reports (e.g. Klohnen, Weller, Luo, & Choe, 2005), we found a clear difference in a fundamental, automatic mechanism at the bodily level, which is known to have important consequences for affiliation and other social processes. Our results show that although attachment styles reflect the same affective and cognitive constructs across relationships, this may not be translated into the same automatic non-verbal behaviours. This has implications not only for future work investigating embodied processing within social relationships, but also for any application of adult attachment theory to non-verbal settings.

In conclusion, we found increased self-other overlap in embodied motor representations between romantic partners as compared to close, platonic friends. A widely-used measure of attachment anxiety was related to this automatic motor resonance, in a positive direction for romantic partners and a negative direction for friends. Existing research into romantic relationships has highlighted a link between attachment style and self-other overlap at a conceptual level (Aron et al., 1991). However, ours is the first to identify a similar link with self-other overlap of *embodied* representations. A rapidly growing field of literature is revealing strikingly broad effects of bodily self-other overlap on social cognition (e.g. Barsalou, Niedenthal, Barbey, & Ruppert, 2003; Gallese, 2007; Gutsell & Inzlicht, 2010; see Maister & Tsakiris, 2015), and it is therefore an important avenue for further research to now apply this new knowledge to our understanding of close personal relationships.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.cognition.2016.03.018.

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