

Metacognition over time is related to neurocognition, social cognition, and intrapsychic foundations in psychosis

Marina Kukla^{a,b,*}, Paul H. Lysaker^{c,d}

^aHSR&D Center for Health Information and Communication, Richard L. Roudebush VA Medical Center, 1481 W. 10th Street, Indianapolis, IN, USA

^bIndiana University-Purdue University Indianapolis, Department of Psychology, 402 N. Blackford St., Indianapolis, IN 46202, USA

^cRoudebush VA Medical Center, 1481 W. 10th Street, Indianapolis, IN 46202, USA

^dIndiana University School of Medicine, 340 W. 10th Street, Suite 6200, Indianapolis, IN 46202, USA

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ABSTRACT

Core impairments underlying schizophrenia encompass several domains, including disruptions in metacognition, neurocognition, social cognition, and intrapsychic foundations. Little is known about how these phenomena change over time and whether changes co-occur. The current study sought to address these gaps and examine the relationships between these cognitive domains across a 12 month period in adults with schizophrenia. Seventy-five adult outpatients with schizophrenia spectrum disorders were enrolled in a randomized trial comparing two cognitive interventions designed to improve work performance. Cognitive outcomes were measured at baseline, a 6-month follow-up and a 12-month follow-up. Multilevel linear modeling was used to understand the longitudinal relationships between metacognition and social cognition, neurocognition, and intrapsychic foundations across the 12-month follow-up. Metacognition significantly improved across 12 months. Improvements in overall neurocognition were significantly associated with increases in the metacognition domains of self-reflectivity and mastery across time. Improvements in social cognition over time were associated with improvements in total metacognition and the metacognitive domain of mastery. Improvements in intrapsychic foundations scores over 12 months were significantly associated with improvements in overall metacognition, self-reflectivity, and mastery. In conclusion, over time, improvements in metacognition across domains co-occur with other core cognitive and social capacities in persons with schizophrenia. As persons became better able to form integrated senses of themselves and adaptively use this knowledge, improvements in neurocognition, social cognition, and intrapsychic foundations were also present.

1. Introduction

For over 40 years, metacognition has been used as an umbrella term to describe the processes which enable persons to not only experience the world, but to experience and reflect upon themselves as they experience the world (Moritz and Lysaker, 2018). Metacognitive processes have been suggested to involve several distinct activities related to awareness of the self (self-reflectivity), awareness of others mental activities (awareness of others), awareness that others have valid differing perspectives (decentration), and the use of metacognitive knowledge to respond to psychosocial challenges (mastery) (Semerari et al., 2003).

With the recognition that sufficient levels of metacognition are necessary for health, adaptation, and social bonds (Lysaker et al., 2018a), interest has grown over the last decade regarding the major role that deficiencies in metacognition play in the expression and course of some

of the most disabling psychiatric conditions, particularly, schizophrenia. Specifically, it has been suggested that impairments in metacognitive capacity may result in the fragmented experience of thoughts, affects and wishes, which Bleuler (1950) considered to be the core features of schizophrenia (Lysaker et al., this issue), as well as in the profound alienation and disturbances in first person experience described by psychoanalysis (Hamm and Lysaker, 2016), existential psychiatry (Lysaker et al., 2018b), and first person accounts (Hamm et al., 2018). Supporting these possibilities are at least three streams of research. First, studies have found that persons with schizophrenia commonly experience more severe forms of metacognitive deficits relative to persons with less severe forms of mental disorders and persons without identifiable mental conditions (Lysaker et al., 2013b). Second, research suggests that persons with schizophrenia with graver metacognitive deficits experience poorer levels of concurrent functioning (Lysaker et al., 2011b) and subjective recovery (Kukla et al., 2013).

* Corresponding author at: 1481 W. 10th Street, 11H, Indianapolis, IN 46202, USA.

E-mail addresses: mkukla@iupui.edu (M. Kukla), plysaker@iupui.edu (P.H. Lysaker).

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Third, studies suggest that persons with schizophrenia who experience metacognitive deficits are more likely to experience a range of future psychosocial and psychiatric challenges, including poorer work functioning (Lysaker et al., 2010), higher levels of negative symptoms (McLeod et al., 2014), and lower levels of intrinsic motivation (Luther et al., 2016).

While this literature points to the importance of metacognition in terms of understanding these current and future aspects of recovery and disability, it remains unclear whether improvements in metacognitive capacity are associated with concurrent improvements in other core areas of cognitive functioning. Theoretically, growth in metacognitive capacity should allow persons to recognize and acknowledge different aspects of themselves and others in a more nuanced manner, allowing for more effective self-management, and thus, greater movement toward recovery (Lysaker and Lysaker, 2017). However, the underlying cognitive processes and pathways by which these functional and recovery outcomes become manifest in the context of changing metacognition is unclear.

To address these issues, this study examined whether changes in metacognitive capacity assessed at three time points over the course of one year among adults with schizophrenia spectrum disorders were related to concurrent changes in with two other forms of cognition and an assessment of the foundations of social relationships. The two forms of cognition under study, neurocognition and social cognition, have been found to be foundational processes related to outcome in schizophrenia research which are related (Hamm et al., 2012; Ventura et al., 2011), yet distinct from the construct of metacognition (e.g., Lysaker et al., 2013a; Fanning et al., 2012; Minor and Lysaker, 2014). Neurocognition refers to a range of generalized abilities such as verbal memory, executive functioning, and processing speed (Green, 1996), while social cognition also refers to a range of abilities related to recognizing what others are doing and thinking, such as emotion recognition and Theory of Mind (Mancuso et al., 2011). Though neurocognition and social cognition are not synonymous with adequate metacognitive function, the function of each depends to an extent upon the function of the others; that is, positive change in metacognitive capacity could be bidirectionally related to positive changes in neurocognition and social cognition (Hasson-Ohayon et al., 2015; Fanning et al., 2012). For example, the ability to notice and remember salient information about a specific person and the ability to correctly judge that person's emotions and intentions is not the same as integrating that information into a flexible and complex sense of that other person.

The third construct under study is the foundational psychological elements needed for interpersonal connections, intrapsychic foundations. Impairment in intrapsychic foundations is found in schizophrenia and is linked with more severe symptoms (Kukla et al., 2014) and poorer neurocognitive function (Fervaha et al., 2014). Intrapsychic foundations is composed operationally by a number of distinct constructs including empathy, intrinsic motivation, sense of purpose and hedonic responses to interactions (Heinrichs et al., 1984), which are generally positively correlated with metacognitive capacity across short periods (Lysaker et al., 2019), particularly in the area of mastery (Lysaker et al., 2011a). Similar to relationships with neurocognition and social cognition, it is also likely that intrapsychic foundations and metacognition may affect one another bidirectionally, such that an increase in the capacity for one might be related to an increase in the capacity for the others. For example, with a more nuanced sense of one's own wishes and emotions, anhedonia might decrease while motivation and sense of purpose might improve. In parallel, as a person develops a greater sense of purpose and motivation, they may also be better able to understand themselves and others in the world and demonstrate mastery.

Examining changes in metacognition, neurocognition, social cognition and intrapsychic foundations over time, across multiple follow-up periods, it was hypothesized that overall metacognitive capacity and metacognition domains would improve over time, given enrollment in

rehabilitation services. Second, it was hypothesized that improvements in neurocognition, social cognition, and the foundations of social connections would co-occur with improvements in metacognition over time. Lastly, additional exploratory analyses examined the relationships between the metacognitive domains of self-reflectivity, awareness of the other, decentration and mastery, with the other cognitive abilities.

2. Methods

Study procedures were approved by the institutional review boards of [University] and the [VA]. The current study is a secondary analysis of a randomized controlled trial examining the effects of cognitive behavioral therapy enhanced with cognitive remediation (CBT + CR) compared to cognitive behavioral therapy alone (CBT) and a vocational support condition on work functioning in adults with schizophrenia. After providing informed consent, 75 participants were randomized to one of the three study conditions: Vocational support ($N = 25$), work-focused CBT ($N = 25$), or work-focused CBT enhanced with CR; CBT + CR ($N = 25$). The intervention was 26 weeks during which participants were placed in noncompetitive work positions and attended weekly CBT and CR training sessions according to condition assignment. Outcomes were measured at baseline and 6 and 12 month follow up periods. Assessments were performed by research assistants blinded to study condition.

2.1. Participants

Seventy-five adult with a Statistical Manual of Mental Disorders, Fourth Edition (SCID-I First et al., 1994) diagnoses of schizophrenia ($n = 53$; 71%) or schizoaffective disorder ($n = 22$; 29%) were recruited from August 2009 to September 2013. Full sample background characteristics are presented elsewhere (Kukla et al., 2018). Overall, the sample was comprised mainly of male, African American and white veterans receiving services in an urban VA setting. Inclusion criteria were unemployment, a goal of working, and in a non-acute phase of mental illness, defined by no medication changes or hospitalizations within one month of study entry. Exclusion criteria were presence of a medical condition preventing study participation. During the study, participants received standard outpatient psychiatric treatment.

2.2. Measures

The Indiana Psychiatric Illness Interview (IPII) is an open-ended semi structured interview that assesses how people schizophrenia understand their experiences with psychiatric illness. Trained raters administered the 30 to 60 min interview in which participants are prompted to tell stories of their lives and how they understand their psychiatric illnesses and the impacts on their lives. As described below, the MAS-A is then used to rate the IPII and determine metacognitive capacities.

Metacognition was measured using the Metacognition Assessment Scale (MAS-A) via ratings of IPII transcripts completed by trained raters. The MAS-A produces a total score of overall metacognitive ability and four subscale scores: self-reflectivity, measured on a 0–8 point likert scale, Awareness of the mind of the other, measured on a 0–6 point likert scale, Decentration, measures on a 0–2 likert scale, and Mastery measured on a 0–8 likert scale. Higher scores indicate better metacognitive capacity. The MAS-A has been used extensively, demonstrating good reliability and criterion related and construct validity (Lysaker et al., 2005).

Neurocognition was measured using the MATRICS Consensus Cognitive Battery (MCCB; Nuechterlein et al., 2008). The MCCB has been widely used in studies of people with schizophrenia displaying good psychometric properties (Green et al., 2008). The MCCB consists of an overall composite score and seven cognitive domains subtests scores. The study focused on the composite score and social cognition

domain in order to understand key relationships between these important capacities and metacognition over time.

The **Heinrichs-Carpenter Quality of Life Scale (QLS; Heinrichs et al., 1984)** is a 21-item measure that is clinician rated on a 0 to 7 likert scale using information gleaned from a semi-structured interview. Higher scores indicate better quality of life. The QLS consists four domains; this study focused on the intrapsychic foundations domain because it assesses the social foundations of quality of life. The QLS has strong inter-rater reliability (Heinrichs et al., 1984) and validity (Lehman et al., 1993).

Social cognition was measured by the MATRICS cognitive battery social cognition scale and the Beck Lysaker Emotional Recognition Task (BLERT). The MATRICS social cognition scale is derived from the Mayer-Salovey-Caruso Emotional Intelligence Test “emotion management” subscale which gauges emotion regulation. Used broadly in adults with schizophrenia, the BLERT asks persons to make judgments about neutral, negative, and positive affective states displayed by actors in brief video clips. The BLERT has demonstrated strong test retest reliability and validity (Bell et al., 1997).

Psychiatric symptoms were measured by the Positive and Negative Syndrome Scale (PANSS) Psychiatric symptoms at baseline were assessed by the Positive and Negative Syndrome Scale (PANSS; Kay et al., 1987) a 30 item measure rated on a 7-point scale ranging from “Absent” to “Extreme”. Research examining the psychometric properties of the PANSS in persons with schizophrenia has found the instrument to have strong inter-rater reliability (e.g., Lysaker et al., 2009).

2.3. Missing data

Sixty-seven participants who completed at least one follow-up assessment were included in the analyses. The remaining 8 participants were randomized to a condition, completed the baseline assessment, but were lost to follow-up. Participants with missing data did not significantly differ from others with regard to baseline levels of metacognition, neurocognition, social cognition, or intrapsychic foundations, $p > .05$.

2.4. Statistical analyses

Mixed models were used to test the hypotheses because this approach effectively accounts for the nested nature of repeated measures data. Furthermore, although the analyses considered metacognition to be the outcome variable, the bi-directional basis of the study and the methods (i.e. data collected concurrently across time) prevent conclusions from being formed regarding temporal sequence.

Analyses were conducted using SPSS 20. Preliminary analyses examined differences between the study conditions on cognitive outcomes. Because there were no significant differences between condition, this was not included as a covariate. Hypothesis testing examined the trajectory of outcomes over time and the association between social cognition, neurocognition, intrapsychic foundations with metacognition using linear mixed models (LMM) for repeated measures. Fixed effect of time examined the trajectory of metacognition over time and the longitudinal relationships between social cognition, neurocognition, and intrapsychic foundations with metacognition. Random effects were utilized for intercepts. Significance values were set at 0.05.

3. Results

Background characteristics were not significantly related to metacognition outcomes over time. Further, symptoms were examined as covariates in the main analyses. Because the results were unchanged after accounting for symptoms, those findings are not reported.

Descriptive statistics pertaining to primary outcomes across time are displayed in **Table 1**. A significant time effect was found for MAS-A total scores across the 12-month follow up period, as participants improved

Table 1
Descriptive statistics for main outcome variables across time, $N = 75$.

Variable	Baseline	6-month follow-up	12-month follow-up
	M(SD)	M(SD)	M(SD)
MAS-A total	11.20 (3.78)	12.00 (3.29)	13.44 (4.38)*
MAS-A self-reflectivity	4.31 (1.46)	4.87 (1.53)	5.16 (1.74)*
MAS-A understanding others	2.78 (0.88)	2.85 (0.76)	3.10 (0.93)
MAS-A decantation	0.55 (0.52)	0.44 (0.46)	0.69 (0.60)
MAS-A mastery	3.58 (1.65)	3.84 (1.43)	4.50 (1.70)*
MCCB total	24.12 (10.10)	25.24 (10.42)	27.55 (10.07)*
MCCB social cognition	34.95 (11.56)	36.57 (12.66)	36.52 (12.56)*
BLERT scores	12.95 (3.58)	13.43 (4.06)	13.49 (3.67)*
QLS intrapsychic foundations	19.48 (5.65)	20.57 (5.96)	21.82 (6.02)

* Significant improvement across 12 months at $p < .05$ level.

over time in overall metacognition, $F(1,68.12) = 7.99, p = .01$. Similarly, participants significantly improved across 12 months in self-reflectivity, $F(1,62.86) = 8.06, p = .01$, and mastery, $F(1,68.87) = 7.94, p = .01$. Understanding others' minds also improved over time, but did not reach statistical significance at the 0.05 level, $F(1,72.75) = 3.38, p = .07$. Decantation also trended toward improvement, but did not significantly change over time, $p > .05$.

As displayed in **Table 1** and **Fig. 1**, significant improvements in MCCB total scores over time significantly predicted improvements in MAS-A self-reflectivity scores over time, $F(1,106.20) = 4.50, p = .036$. Similarly, as displayed in **Fig. 2**, changes in total MCCB scores were significantly associated with changes in mastery across 12 months, $F(1,96.18) = 8.85, p = .004$. MCCB total scores were not significantly associated with changes in MAS-A total scores, understanding of others' minds, or decantation across time, $p > .05$.

As demonstrated in **Table 1** and **Fig. 3**, significant improvements in social cognition over time as measured by the BLERT significantly predicted improvements in MAS-A total scores over time, $F(1,125.56) = 4.85, p = .029$. Furthermore, significant improvements in MCCB social cognition scores were significantly associated with improvements in MAS-A mastery across 12 months, $F(1,117.57) = 4.28, p = .041$. Social cognition scores over time were not significantly associated with changes across time in MAS-A self-reflectivity, understanding of others' minds, or decantation, $p > .05$.

As displayed in **Table 1** and **Fig. 4**, improvements in QLS intrapsychic foundations over time were significantly associated with improvements in MAS-A total scores over time, $F(1,135.21) = 11.95, p = .001$. Second, changes in QLS intrapsychic foundations scores were significantly associated with improvements in MAS-A mastery across

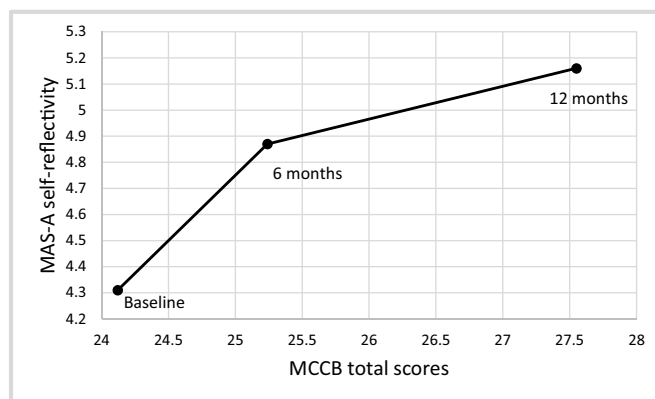


Fig. 1. Relationship between neurocognition and MAS-A self-reflectivity across time, $N = 75$.

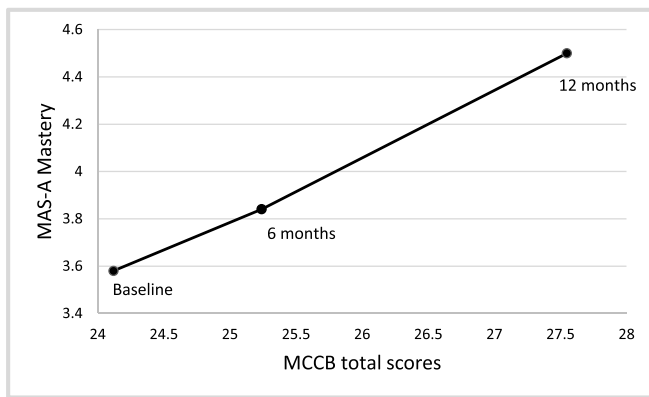


Fig. 2. Relationship between neurocognition and MAS-A mastery across time, $N = 75$.

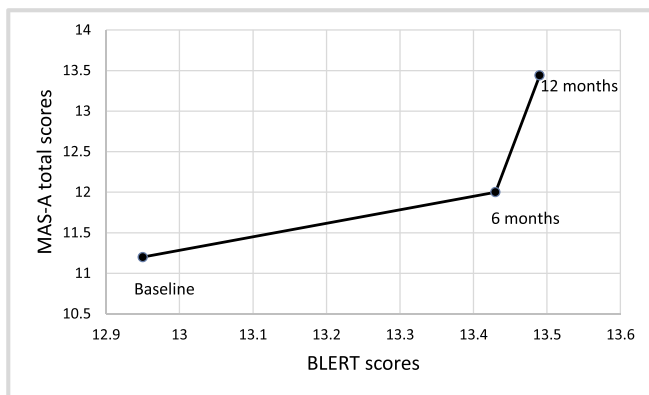


Fig. 3. Relationship between social cognition and overall metacognition over time, $N = 75$.

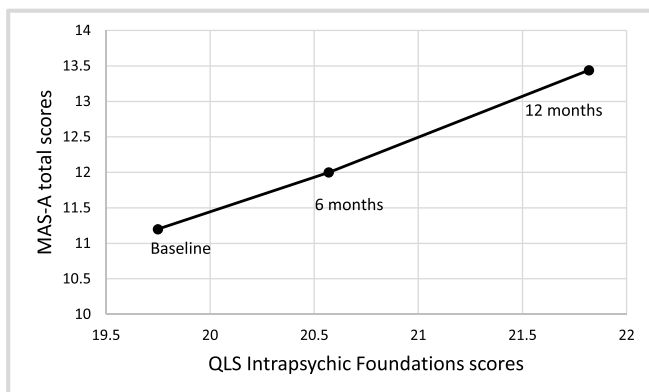


Fig. 4. Relationship between intrapsychic foundation scores and overall metacognition across time, $N = 75$.

12 months, $F(1,128.05) = 22.08, p = .00$. Third, improvements in intrapsychic foundations scores were also significantly associated with improvements in MAS-A self-reflectivity over time, $F(1,139.56) = 12.68, p = .001$. Intrapyschic scores over time did not were not significantly associated with changes across time in MAS-A understanding of others' minds or decentration, $p > .05$.

4. Discussion

People with schizophrenia often have impairments in key areas of metacognition and related cognitive capacities that are associated with disruptions in psychosocial function and sense of self. Until now,

research has either been cross sectional or featured short follow-up periods. Thus, there has been little research examining whether changes in metacognition are related to changes in other core cognitive outcomes over longer periods at multiple follow up points in people with schizophrenia spectrum disorders who are receiving psychiatric rehabilitation treatments. Accordingly, the goals of this study were two-fold; first, the study sought to characterize changes in metacognition take place across 12 months and second, the study aimed to understand the relationship between metacognition and changes social cognition, neurocognition, and intrapsychic foundations over time. Consistent with the hypotheses, results indicate that participants' overall metacognitive capacity significantly improved over one year and particularly in the areas of self-reflectivity, or awareness and integration of one's own mental activities, as well as mastery, or the integration and use of knowledge about oneself and others to effectively face life challenges and enact appropriate self-management strategies. These findings suggest that when actively engaged in mental health treatment and rehabilitation, metacognition may continue to grow across time in this population.

In addition, longitudinal improvements in metacognition were associated with concurrent increases in overall neurocognition, social cognition and intrapsychic foundations scores across one year. In building upon extant literature demonstrating their linkages at one point in time (e.g., Lysaker et al., 2005; Lysaker et al., 2013a, 2013b), these interrelated capacities continue to emerge in parallel over longer periods. Regarding neurocognition, one interpretation may be that some level of cognitive functioning is necessary for a level of metacognition to be achieved over time. It is also possible that neurocognition and metacognition are connected such that each is necessary for the other to function and grow over the long term. Furthermore, results demonstrated that most gains in social cognition occurred from baseline to 6 months with more modest increases from 6 months to 12 months; in contrast, mastery had a steady increase from baseline to 1 year. This set of findings may suggest that correctness of reading emotions and the choice of effective emotional management strategies is foundational to more basic levels of mastery. Then, as persons use and integrate this emerging emotional content, in combination with the acquisition of greater self-reflective capacity, they gain an increasing higher-order ability to masterfully deal with life dilemmas.

Lastly, intrapsychic foundations scores improved linearly over time and were significantly associated with emerging metacognitive capacity, particularly in the domains of mastery and self-reflectivity. Although previous research has found that intrapsychic foundations improve over shorter spans of time in people with schizophrenia who take part in work rehabilitation, it was unclear what parallel cognitive processes may play a role (e.g., Bryson et al., 2002). Regarding the development of self-reflectivity, it may be that gaining the ability to integrate thoughts and emotions about the self and establish where one fits in the interpersonal world leads to more motivation and purpose in relationships, a complex process that evolves over time. Further, the trend of improving mastery occurring in parallel with increases in the foundational aspect of social relatedness fits with prior work concluding that these intrapsychic foundations may be achieved as people with schizophrenia perceive themselves as active agents in the world who hold a strong sense of recovery (e.g., Kukla et al., 2014).

This study has limitations that should be acknowledged. Although the relationships between these foundational impairments in schizophrenia were examined longitudinally using appropriate statistical models to account for nested, repeated measures data, the temporal sequence of variables cannot be firmly determined. Specifically, it is unclear whether improvements in metacognition facilitated gains in the other cognitive domains, vice versa, or whether these gains emerged in parallel. Furthermore, the sample size was somewhat modest, potentially increasing the risk of Type II error; this is noteworthy because some important metacognitive domains (e.g., understanding of other) demonstrated improvement over time, yet this trend did not reach

statistical significance. Future research should study the crucial relationships between these core cognitive capacities in larger samples of adults with schizophrenia and over longer follow-up periods to capture emerging abilities at higher ends of the metacognitive spectrum.

The findings of the current study have important implications for practice. They highlight the potential of metacognition as a crucial target for psychotherapy. An emerging intervention, the Metacognitive Reflection and Insight Therapy (MERIT), is designed to improve metacognitive capacity in people with schizophrenia (Lysaker and Klion, 2017). Mounting evidence suggests that this intervention may be beneficial to multiple domains of metacognition (de Jong et al., 2018), leading to improvements in areas such as insight (Vohs et al., 2018), functioning (e.g., Kukla et al., 2016), symptoms (Arnon-Ribenfeld et al., 2017), as well as helping persons build a coherent self-concept and personal agency that are key to meaningful recovery (e.g., Hamm and Firmin, 2016; Lysaker et al., 2015). Fitting with these current findings, it may be with improving metacognition comes gains in other important cognitive and social domains.

Conflict of interest

Authors have no conflicts of interest to disclose.

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