Introduction
Previous work has established that methamphetamine (MA) abuse is associated with functional and structural brain changes, particularly in the frontal and temporal lobes. It has also been shown that MA abuse may induce a psychotic disorder as a result of its neurotoxicity. Based on a literature showing decreased cortical thickness in amphetamine-type stimulants [1] and grey matter density reductions in methamphetamine abusers [2], we hypothesized that participants with MA dependence exhibit cortical thinning, especially in fronto-temporal regions. It has not yet been ascertained whether MA dependent individuals with and without a history of psychosis demonstrate differences in pattern of cortical thickness, and we also investigated this issue.

Method
Participants
We obtained magnetic resonance images (3T multiecho MP-RAGE) from 19 MA dependent individuals with substance-induced psychosis (PSY group, treated with first generation antipsychotics), 21 participants with MA dependence and no psychosis (MA group), and 18 age and gender matched healthy controls (CTRL group). Participants were recruited from drug rehabilitation facilities, hospitals and communities in Cape Town. Trained interviewers conducted a face to face psychiatric assessment using the SCID-I for DSM-IV-TR [3]. Participants were excluded from the study if they presented with: 1) additional substance dependencies other than nicotine, with exception of methamphetamine for the MA and PSY group; 2) lifetime and current diagnosis of psychiatric disorders, with exception of psychosis in the PSY group; 3) a history of psychosis prior to meth abuse; 4) a medical or neurological illness or head trauma; 5) a seropositive test for HIV; 6) MRI incompatibilities or known claustrophobia; 7) a left-handedness.

Scans and Analysis
Images were acquired at the Cape Universities Brain Imaging Centre, CUBIC, using a Siemens Magnetom Allegra 3T system with a high-resolution, T1-weighted, 3D-MEMPRAGE sequence with the following scan parameters: TR=2530ms; graded TE=1.53, 3.21, 4.89, 6.57ms; flip angle=77°; FOV=256mm; slice thickness=1mm; 160 slices. Regional estimates of cortical thickness and subcortical volumes were assessed employing a surface-based cortical reconstruction and automatic labelling tool in the FreeSurfer v5.1 software package (http://surfer.nmr.mgh.harvard.edu/). Cortical thickness group analysis (general linear model) was done with FreeSurfer’s tool Qdec, including age as nuisance variable. Cluster size threshold was set to number of vertices>50.

Results
MA abusers showed compared to healthy controls cortical thinning in mainly frontal areas of left hemisphere, but reduced cortical thickness in the left caudal anterior cingulate cortex (Table 2). MA abusers with a history of psychosis showed compared to healthy controls cortical thinning in parietal, temporal and frontal areas and also reduced cortical in the left caudal anterior cingulate cortex (similar coordinates and extent as MA group) and postcentral cortex (Table 3). A comparison of the two MA abusing groups shows a heterogeneous pattern of differences in cortical thickness (Table 4).

Conclusions
The findings of cortical thinning in MA dependent participants with and without psychosis were contrary to our expectations. However, increased cortical thickness has been seen in other populations with alcohol or substance use and may represent a compensatory response to MA-induced ischaemic or neurotoxic injury, pointing to inflammation or reactive gliosis. The anatomically more widespread effects on cortical thickness in MA abusers with a history of psychosis might coincide with structural changes of the progressing disease. Further work is needed to replicate the findings here, and to determine the relevant molecular mechanisms.

References

Contact
University of Cape Town
Department of Psychiatry and Mental Health J2-Block, Groote Schuur Hospital Observatory, Cape Town 7925, South Africa
+27 21 4066843
Anne.Uhlmann@uct.ac.za

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