Remark (∗). Any substitution, in particular σ, only changes a finite number of variables. Furthermore a result of a run of the unification algorithm is acyclic in the sense that if a substitution $u \mapsto t$ is added to the resulting substitution, it is never the case that at a later stage $t \mapsto u$ is added. This can easily be seen by considering that at the point when $u \mapsto t$ is added to the resulting substitution, every occurrence of u is replaced by t, so u is not encountered by the algorithm at a later stage.
Therefore in order to show that a statement holds for every $u \mapsto t$ in a unifier σ, it suffices to show by an induction argument that for every substitution $v \mapsto s$ which is added to the resulting unifier by the unification algorithm that it holds for $v \mapsto s$ under the assumption that it holds for every $w \mapsto r$ such that w occurs in s and $w \mapsto r$ is added to the resulting substitution at a later stage. △

Conjecture 1. *Let C be a clause in a resolution refutation. Suppose that $\mathrm{AI}^{\Delta}(C)$ contains a maximal Γ-term $\gamma_j[x_i]$ which contains a lifting variable x_i (lifting a Δ-term δ_i). Then there is an arrow in $\mathcal{A}^*(C)$ from an occurrence of x_k in $\mathrm{AI}^{\Delta}(C)$ such that δ_k is an abstraction of δ_i to $\gamma_j[x_i]$.*

Proof. We proceed by induction. For the base case, note that no multicolored terms occur in inital clauses, so no lifting term can occur inside of a Γ-term.
Suppose a clause C is the result of a resolution of $C_1 : D \vee l$ and $C_2 : E \vee \neg l$ with $l\sigma = l'\sigma$. Furthermore suppose that for every lifting term inside a Γ-term in the clauses C_1 and C_2 of the refutation the desired arrows exist. We show that the same holds true for every new term of the form $\gamma_j[x_i]$ for some j, i in $\mathrm{AI}^{\Delta}(C)$. By "new", we mean terms which are not present in $\mathrm{AI}^{\Delta}(C_1)$ or $\mathrm{AI}^{\Delta}(C_2)$. Note that new terms in $\mathrm{AI}^{\Delta}(C)$ are of the form $\ell_{\Delta,x}[t\sigma]\tau$ for some $t \in \mathrm{AI}^{\Delta}(C_1) \cup \mathrm{AI}^{\Delta}(C_2)$. By Lemma **??**, σ does not introduce lifting variables. Hence a new term of the form $\gamma_j[x_i]$ is created either by introducing a Δ-term into a Γ-term or by introducing $\gamma_j[\delta_i]$ via σ, both followed by the lifting. Note that τ only substitutes lifting variables by other lifting variables and hence does not introduce lifting variables. Furthermore by Lemma **??**, τ only substitutes lifting variables for other lifting variables, whose corresponding term is more specialised. Hence if ther exists an arrow from a lifting variable to $\gamma_j[x_i]$ according to this lemma, it is also an appropriate arrow if $\gamma_j[x_i]$ is replaced by $\gamma_j[x_i]\tau$.
We now distinguish the two cases under which a new term $\gamma_j[x_i]$ can occur in $\mathrm{AI}^{\Delta}(C)$:

Suppose for some Γ-term $\tilde{\gamma}_j[u]$ in $\mathrm{AI}^{\Delta}(C_1)$ or $\mathrm{AI}^{\Delta}(C_2)$, $(\tilde{\gamma}_j[u])\sigma = \gamma_j[\delta_i]$ for some i.

> **The substitution can also introduce a grey term containing a delta term, make sure to handle that!**

The substitution can also introduce a gamma term containing a delta term, make sure to handle that!

TODO:

Suppose for some variable v in $\mathrm{AI}^{\Delta}(C_1)$ or $\mathrm{AI}^{\Delta}(C_2)$, $v\sigma = \gamma_j[\delta_i]$ for some i.

As v is affected by the unifier, it occurs in the literal being unified, say w.l.o.g. in l in C_1. At one point in the unification algorithm, v is substituted by an abstraction of $\gamma_j[\delta_i]$. Let p be the position of the occurrence of v in l which leads to this situation. Furthermore, let p' be the position corresponding to p in l'.

Note that any arrow from or to p' also applies to p in $\mathcal{A}^*(C)$ and hence to $\gamma_j[x_i]$ as they are merged due to occurring in the resolved literal. So it suffices to show that there is an arrow from an appropriate lifting variable to p'. We denote the term at p' by t.

Note that $t\sigma = \gamma_j[\delta_i]$. So t is either a Γ-term containing a Δ-term, in which case we know that there is an appropriate arrow by the induction hypothesis as t occurs in l' in C_2, or t is an abstraction of $\gamma_j[\delta_i]$, in which case we can assume the existence of an appropriate arrow by Remark $(*)$. $\square$