

Investigating the role of hallucinatory experiences in the transition from suicidal thoughts to attempts






Hielscher E, DeVlyder J, Connell M, Hasking P, Martin G, Scott JG. Investigating the role of hallucinatory experiences in the transition from suicidal thoughts to attempts.

Objective: Psychotic experiences, including auditory hallucinatory experiences (HEs), are strongly associated with both suicidal thoughts and behaviour. This study examined their role in the ideation-to-attempt transition in adolescents, including their direct and indirect effect via potential mediators.

Method: Participants were from an Australian prospective longitudinal cohort of 1669 adolescents (12–17 years); of which a subsample endorsing baseline suicidal ideation ($n = 216$) was the focus of most analyses. Suicidal thoughts and behaviours were measured using the Self-Harm Behaviour Questionnaire. The Diagnostic Interview Schedule for Children was used to assess auditory HEs. Potential mediators of interest were psychological distress and Interpersonal Theory of Suicide (IPTS) constructs.

Results: Among adolescents reporting suicidal ideation at baseline ($n = 216$), 6.5% had attempted suicide during follow-up. The size of auditory HEs' univariate effect suggests a possible strong relationship with increased risk of incident suicide attempts (OR = 2.40; 95%CI = 0.76–7.56); however, there was inadequate statistical power to produce a precise estimate. When HEs were accompanied by distress there was a nine-fold increased risk of acting on suicidal thoughts. Distress was independently associated with risk of attempt transition (OR = 4.09), whereas IPTS constructs were poor explanatory variables in most models.

Conclusion: Adolescents with psychological distress and auditory HEs are at high risk of incident suicide attempts. Further investigations on the role of negative/distressing content of hallucinations in the ideation-to-attempt transition are warranted.

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Key words: psychotic experiences; hallucinations; self-injurious behaviour; suicide; interpersonal theory of suicide

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Significant outcomes

- Adolescents who acted on their suicidal thoughts were more likely to be both highly distressed and report auditory hallucinatory experiences (HEs).
- The distress \times auditory HEs interaction was a better predictor of future suicide attempts compared with IPTS-related variables, a widely accepted theory of suicidal behaviour.
- To continue advancing knowledge, studies should consider the temporal lag between suicidal thoughts and behaviours and be informed by both data-driven and theoretical frameworks.

Limitations

- Generalisability is limited as our sample was drawn largely from Catholic schools.
- Our study, like other longitudinal studies, experienced attrition. Of note, those who reported suicidal ideation at baseline were more likely to be lost to follow-up.
- All key variables used in the study were self-reported and thus are prone to recall bias, and proxy measures were used to capture IPTS theoretical constructs.

Introduction

Psychotic experiences (PEs), including hallucinatory and delusional experiences, are common among adolescents (1, 2) and are associated with a broad range of adverse health and social outcomes including suicidal thoughts and behaviours (3–6). Adolescent longitudinal studies (7–9) have shown PEs predict suicide attempts with large effect sizes, and other youth studies have reported dose-response relationships with regard to both number of PEs (10, 11) and severity of self-injurious behaviour (7, 12, 13). The reason for the association between PEs and self-injurious thoughts and behaviours is unknown, and research to date has largely adopted an atheoretical approach (14). This oversight applies to self-harm and suicide research more broadly, where few studies are theoretically driven (15) but such frameworks are needed to organize the often-fragmented findings in the field.

Theoretical models may provide a framework to better understand the PE-suicidal behaviour association. They inform our understanding of the intra- and interpersonal context of subsequent suicide risk (16), which is essential for informing interventions. Traditionally cited suicide risk factors (e.g. depression and impulsivity) are non-specific and fail to predict the transition from suicidal thoughts to behaviours (17–19).

Leading theoretical models focus on the transition from suicidal ideation to attempts, including the ideation-to-action theories of suicide such as the Three-Step Theory (20) and the Interpersonal Theory of Suicide (IPTS) (21, 22). The Three-Step Theory proposes that suicidal ideation arises from a combination of (psychological) pain and hopelessness. Connectedness is protective against escalating ideation to attempt. The transition from ideation to attempts is facilitated by dispositional, acquired and practical contributors to suicide (20). The IPTS theory (22) purports that passive suicidal ideation results where people perceive they are a burden to others or are thwarted in their attempts to belong (23). When perceived burdensomeness and thwarted belonging consistently co-occur, active suicidal ideation emerges (23). Transition from active ideation to suicide attempts depends on a reduced fear of death, and tolerance for self-destructive behaviour (i.e. an acquired capability for suicide). A recent systematic review examined the validity of these IPTS constructs among adolescents (12–18 years; $n = 17$ studies), finding moderate support at this life stage, particularly with respect to the association between acquired capability and attempted suicide (15). Among adults,

the evidence is strongest for the perceived burdensome-suicidal ideation relationship (24).

To date, there has been mixed evidence to suggest that PEs alone contribute to the transition from ideation to attempts. A cross-sectional study of adolescents referred for psychiatric care (aged 10–15 years) reported the presence of auditory hallucinations increased the odds for suicide attempts (OR = 3.4; 95%CI = 2.0–5.7) among those with suicidal ideation, but depression did not (25). Two population representative cross-sectional studies (26, 27) confined to adult populations (18–95 years) showed contrasting results. DeVlyder et al. (26) found among American adults with suicidal ideation ($n = 11\ 716$) that, after adjusting for co-occurring psychiatric disorder, those with PEs were three times more likely than those without PEs to attempt suicide during the same (past 12-month) period (OR = 3.49; 95%CI = 1.05–11.58). In contrast, a large retrospective cross-national survey ($n = 33\ 370$ adults) (27) reported PEs did not make an additional contribution to suicide attempts among those with suicidal ideation.

The cross-sectional design of these studies is a significant limitation in investigating change from suicidal thoughts to behaviours. The first aim of the current study was to investigate whether PEs were independently associated with the transition from suicidal ideation to attempts using a two-wave, prospective community cohort of adolescents.

In addition to study design and sampling limitations, none of the above studies explored the explanatory value of ideation-to-action theories with respect to PEs. A prospective cohort study of New Zealand high school students (12–17 years) (23) explored the schizotypy-suicidality relationship and found stronger support for the IPTS than the Three-Step Theory, suggesting such IPTS constructs as perceived burdensomeness, thwarted belongingness and acquired capability for suicide should be considered in further investigations of PEs in the ideation-to-attempt transition. PEs are often identified as distressing (28) and are commonly characterised by negative beliefs about the self and threat-related content, and thus could serve as a mechanism for developing an acquired capability for suicide; as acquired capability typically develops over time through repeated and ongoing exposure to psychologically provocative or fear-inducing events (29). Other support for the PE-acquired capability link has been found in Vossen et al.'s (30) experimental pain study, where PEs were related to decreased pain sensitivity (a key component of acquired capability for suicide)

albeit in a small university sample. In addition, PEs could also serve as a mechanism for increased levels of perceived burdensomeness and thwarted belonging. Strong bidirectional relationships have been identified between positive PEs (i.e. hallucinations and delusions) and the experience of loneliness and perceived social isolation (31, 32). Therefore, the second aim of this study was to investigate whether the IPTS theory helps to explain (i.e. mediates) the role of PEs in the ideation-to-attempt transition.

Common confounding and mediating variables also need to be considered as alternative indirect PE pathways in the ideation-to-attempt transition. A key variable of interest is general psychological distress. PEs are associated with elevated risk for distress (33), and distress as a result of PEs is proposed to lead to self-injurious behaviour (34). In a sample of Australian adolescents with PEs, Martin et al. (35) found individuals reporting psychological distress had significantly higher odds of future suicide attempt, whereas individuals reporting little or no psychological distress did not, supporting previous studies (36, 37). In the current study, we therefore compared an IPTS theoretical model with a model comprised of general psychopathology as potential mediators of PEs in the ideation-to-attempt transition.

Finally, there is evidence that PEs modify the clinical severity of common mental disorders in terms of increased risk for suicide attempts and other negative outcomes (13, 38). It is possible that PEs co-occur and interact with general psychopathology, culminating in a mental state where there is a high risk of progression from suicidal ideation to attempts. The third and final aim of this study was therefore to investigate whether psychological distress moderated the relationship between PEs and attempt transition, resulting in an increased likelihood of suicide attempts in those with suicidal ideation.

Aims of the study

To summarise, the key aims of the present study were to determine: (i) whether PEs are (independently) associated with transition from suicidal ideation to attempts; (ii) whether IPTS theoretical constructs or psychological distress mediate the relationship between PEs and attempt transition; and (iii) whether psychological distress moderates the effect of PEs in the ideation-to-attempt transition. By investigating whether PEs in adolescence have a role in the transition from suicidal ideation to attempts, we aimed to inform the underlying mechanisms that increase risk of suicide attempts

in adolescents with PEs, and thus potentially provide important guidance for both treatment and prevention programmes.

Material and methods

Sample

Participants were drawn from the HEALing Project (Helping to Enhance Adolescent Living), a prospective longitudinal cohort study of Australian adolescents aged 12–17 years. The study has previously been described in detail (35). In brief, 41 secondary schools (23 Catholic, 18 independent) participated. An information sheet and consent form were sent home to parents of 14 841 students, of which 3119 (21.0%) were returned, a participation rate consistent with previous Australian school-based studies of adolescents requiring parental consent (33, 39, 40). Of those with parental consent, 2640 (84.6%) students completed the survey at baseline (T0), and 1975 (74.8% of baseline respondents) completed the survey at 1-year follow-up (T1). Reasons for non-participation at follow-up ($n = 665$; 25.2% of total sample) included absenteeism (65.0%), withdrawal of one school (17.0%), students no longer enrolled at the school (14.0%) and withdrawal by parent or student (4.0%). There were no deaths by suicide in the sample. Four participants were excluded because they were older than 17 years at one or both data collection points (T0 and/or T1), leaving a sample of 1971 for analysis. For most analyses, we focused on the subsample of participants who endorsed suicidal ideation at baseline ($n = 216$). See Fig. 1 for study flow chart.

The study was approved by Monash University and The University of Queensland Research Ethics Committees, with ethical clearance also obtained from relevant Catholic Education Archdioceses.

Key variables

Baseline psychotic experiences. PEs were assessed using four questions from the schizophrenia module of the revised version of The Diagnostic Interview Schedule for Children (DISC-R) (41): lifetime auditory hallucinatory experiences (HEs), and three delusional experiences (DEs) of thoughts being read, receiving special messages and feeling spied upon. Participants responded to each item as either 'no', 'yes, likely' or 'yes, definitely'. These four items have been used to screen for PEs in adolescents (13, 42), and the DISC auditory hallucinatory item has previously been shown to have a high concurrent validity with clinician-rated psychotic symptoms (43) and low susceptibility to social desirability bias (44). In

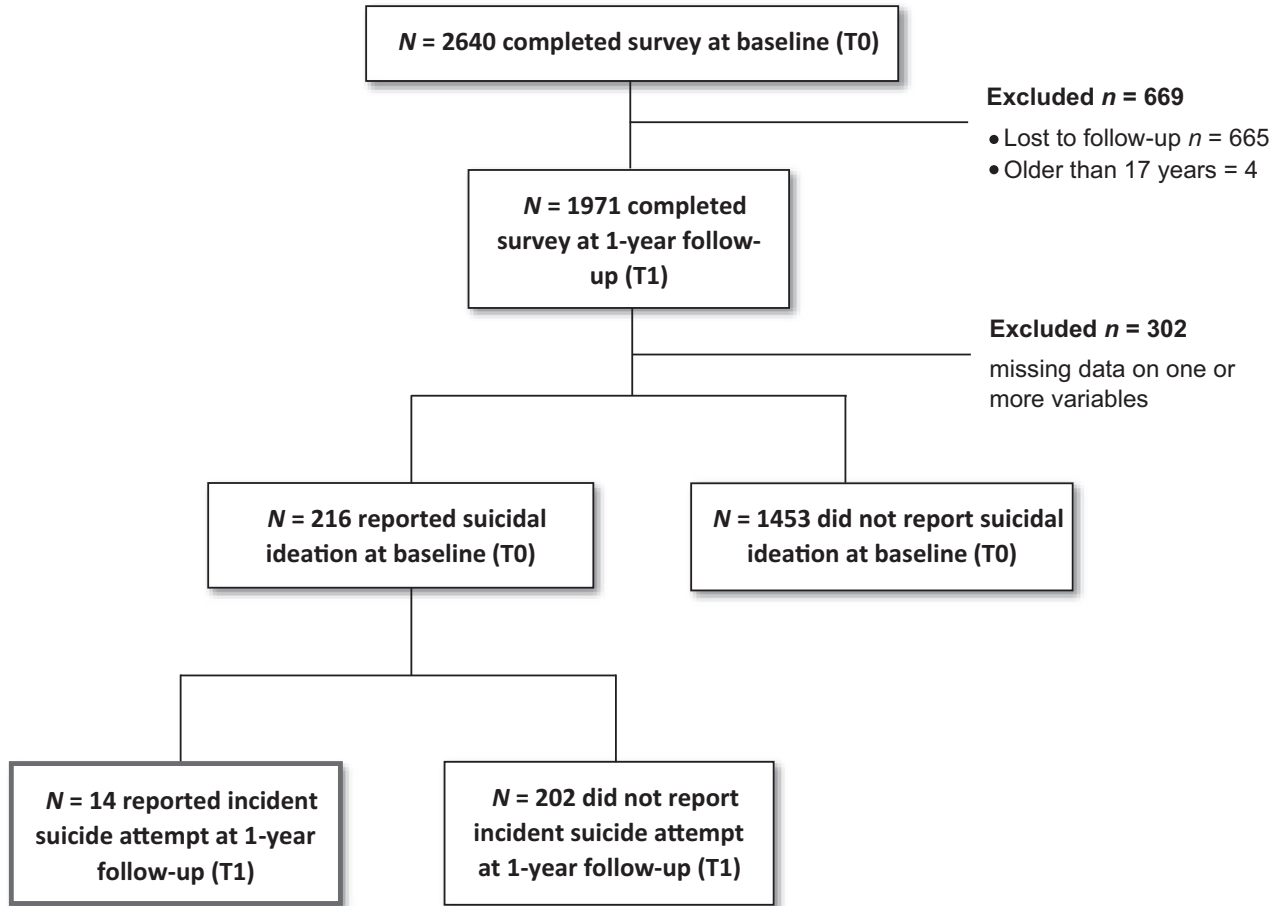


Fig. 1. Flow chart of participants in prospective cohort study.

the current study, we focused on auditory HEs, given a previous nationally representative sample of Australian adolescents ($n = 1998$) (6) showed that auditory HEs was the only PE subtype which remained associated with both self-harm and attempted suicide, after adjustment and consideration for the influence of confounders and mediators. Participants in the HEALing study were classified as endorsing auditory HEs if they responded ‘yes, definitely’ to the DISC-R item ‘heard voices other people cannot hear’ at baseline (T0).

Baseline suicidal ideation. Suicidal ideation was measured using the Self-Harm Behaviour Questionnaire (SHBQ) (45). The SHBQ has good psychometric properties in adolescent and young adult community samples (45, 46). Suicidal ideation was assessed using the item ‘have you ever thought about ending your life?’ (yes or no). Participants were classified as endorsing suicidal ideation if they responded ‘yes’ at baseline (T0).

Incident suicide attempts. Suicide attempts were also measured using the SHBQ (45), assessed using

the item ‘Did you ever try to end your life?’ (yes or no). Incident attempted suicide one year later was coded if the participant responded ‘no’ at T0 but ‘yes’ at T1.

IPTS/other third variables of interest

Perceived burdensomeness. The ‘Responsibility to Family’ subscale is one of five subscales on the Reasons for Living Inventory-Adolescent version (RFL-A) (47). The Responsibility to Family (RFL-A-RF) subscale was incorporated as a proxy measure of perceived burdensomeness, consistent with the approach of previous studies (48, 49). This subscale measures individuals’ beliefs about how their suicide would affect family members (50). See Appendix S1 for further details on the RFL-A-RF, including its acceptable reliability and validity with respect to the ‘perceived burdensome’ latent variable.

Thwarted belongingness. The Multidimensional Scale of Perceived Social Support – Peer (MSPSS-Peer) (51) subscale was incorporated as a proxy

measure of thwarted belongingness, consistent with previous studies (49, 52). Further details on this measure, including its acceptable psychometric properties, can be found in Appendix S1.

Acquired capability for suicide. Van Orden et al. (22) proposed three constructs relevant to acquired capability for suicide: fearlessness about death, pain tolerance, and exposure to painful and provocative events. Ribeiro et al. (53) found the 'acquired capability' latent variable reflected only a sense of fearlessness about death. In the current study, the RFL-A 'Fear of Suicide' subscale (RFL-A-FS) (47) was used to assess a person's fearlessness about death. See Appendix S1 for further details on the RFL-A-FS.

Psychological distress. Psychological distress was categorised using the General Health Questionnaire (GHQ-12) clinical cut-off (54). Although originally developed for adult populations, the GHQ-12 has been validated in adolescents (55). Total GHQ-12 scores were calculated by summing scores (0, 1, 2 and 3) for each item. Participants were classified according to sex-stratified cut-offs previously reported in an Australian adolescent sample (56). Males were classified as experiencing psychological distress if they scored ≥ 13 , and females were classified if they scored ≥ 18 .

Confounders. Previous research has shown age and sex differences in self-injurious thoughts and behaviours (22, 57), as well as in the applicability of the IPTS theory (58, 59), and therefore age (in years) and sex of participants were incorporated as confounders in all analyses.

Attrition and missing data

Adolescents lost to follow-up (LTF; $n = 665$, 25.2% of total sample) were older, more likely to report psychological distress and suicidal ideation at baseline, and report having attempted suicide at baseline. In terms of missing data (302 of 1971 participants), complete case and imputed data were largely consistent, producing similar parameter estimates for all analyses. Complete case data ($N = 1669$) were reported in the results section. See Appendix S2 for further details on attrition and missing data analyses.

Statistical analysis

All analyses were conducted using Stata/IC 14. Preliminary descriptive analyses were conducted to explore normality and skewness, as well as the

frequency and association between variables. Baseline associations between third variables of interest (psychological distress, thwarted belonging, perceived burden and acquired capability) are included in Appendix S3, where no correlation coefficient was above .3, indicating these were relatively distinct constructs. There was also no sign of multicollinearity as indicated by a variance inflation factor (VIF) of less than 3.0 for all variables (60).

Regression modelling. Those endorsing suicidal thoughts at baseline were identified ($n = 216$), and analyses were then restricted to this subsample. To address *Aim 1*, logistic regressions were used to estimate the total effect of baseline auditory HEs on incident suicide attempts.

To address *Aim 2* of the study (i.e. explanatory role of third variables), the direct and indirect effects of auditory HEs on incident suicide attempts were explored using the generalised structural equation modelling (GSEM) function. Potential mediators of interest included: psychological distress (GHQ-12 clinical cut-off), as well as perceived burdensomeness (RFL-A-RF), thwarted belongingness (MSPSS-Peer), acquired capability for suicide (RFL-A-FS) and their two- and three-way interaction terms (i.e. perceived burden x thwarted belonging x acquired capability); the latter of which is predicted by the IPTS theory to have the strongest effect on suicide attempts (22). These potential mediators were divided into two models: a *distress model* (an atheoretical model which focuses on key factors [i.e. psychological distress] identified in previous PE-suicidality epidemiological analyses) and a *theoretical or IPTS model* (which focuses on how IPTS constructs, along with PEs, help to explain the transition from suicidal ideation to attempts). Christensen and colleagues (55) provided a similar breakdown of statistical models into (i) a theoretical (or IPTS) model and (ii) an epidemiological model focused on mental disorders (depression, anxiety and substance use) and demographic predictors. See Appendix S2 for more details on each model in the current study. Both mediation models followed the two-wave approach of MacKinnon and colleagues (61, 62), which incorporates all variables at each time point, and which takes advantage of the temporal lag and longitudinal regression for both links in the proposed causal chain. Specifically, the indirect effect of this model (see Fig. 2) is the product of the two longitudinal paths between the T0 Predictor and T1 Mediator (a_1), and between the T0 Mediator and T1 Outcome (b_1). The goodness-of-fit of GSEM to empirical data was assessed using the Akaike Information Criterion (AIC) and Bayesian

Information Criterion (BIC); where the model with the lowest AIC and BIC values is the optimal one.

To address *Aim 3* of the study (i.e. potential moderation or interaction effect), we conducted a logistic regression analysis, grouped by presence and absence of auditory HEs and psychological distress (or GHQ-12 clinical cut-off). Adolescents were grouped as follows: (i) none or low psychological distress and no auditory HEs (reference group); (ii) auditory HEs only; (iii) psychological distress only; and (iv) psychological distress and auditory HEs. We then examined the association between the four groups and incident suicide attempts using logistic regression. We did not carry out analyses where IPTS variables (perceived burden, thwarted belonging and acquired capability) moderate the auditory HE-attempt association as the theory purports that these theoretical constructs represent proximal predictors of suicide, and as such, account for the relationship between various risk factors and suicidal behaviours. Therefore, IPTS variables would not be expected to moderate the effect of auditory HEs on attempt transition.

Results

There were 1669 participants at T0 and T1, mean age 13.9 (SE = 0.02) at baseline, and 72.1% were female (95%CI = 69.9–74.1). Of the total sample, 216 (12.9%; 95%CI = 11.4–14.6) reported suicidal ideation at baseline, 22 (1.3%; 95%CI = 0.8–1.9) reported suicide attempts at baseline, and 23 (1.4%; 95%CI = 0.9–2.0) reported incident suicide attempts at 1-year follow-up.

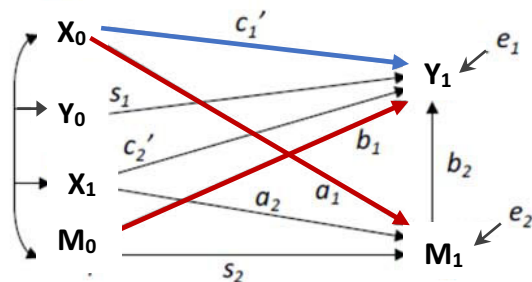
In terms of auditory HEs, 6.6% (95%CI = 5.4–7.9) of the total sample (n = 1669) endorsed these experiences at baseline. Auditory HEs were significantly and independently associated with

baseline suicidal ideation (OR = 3.99; 95% CI = 2.46–6.52) and incident suicide attempts in the following 12 months (OR = 3.16; 95% CI = 1.11–9.04); after adjusting for age, sex, psychological distress and IPTS theoretical constructs. See Appendix S3 for associations between all variables at baseline.

Aim 1: Psychotic experiences in the ideation-to-attempt transition (n = 216)

Of adolescents reporting baseline suicidal ideation (n = 216; 12.9%), 6.5% (n = 14) attempted suicide at 1-year follow-up. Among those reporting a transition from suicidal ideation to attempt, over a third (35.7%) reported auditory HEs at baseline, a population attributable risk of 19.74%. Using a univariate logistic regression model, auditory HEs were not significantly associated with transition from baseline suicidal ideation to suicide attempts one year later, with wide confidence intervals around this estimate (OR = 2.40; 95%CI = 0.76–7.56). We also conducted supplementary follow-up analyses (data not shown) where auditory HEs were grouped by their persistence across the two waves of data (i.e. never, transience and persistence). Statistically non-significant results were found at all levels, although this supplementary analysis should be interpreted with caution as statistical power was low.

Even though the total effect of auditory HEs on incident suicide attempts was not significant, its effect could be entirely indirect. Traditional mediation approaches require a significant total effect of X (auditory HEs) on Y (suicide attempts); however, it is possible for a mediator to be causally between X and Y, even if X and Y are not significantly associated (63–65). Therefore, Aim 2 was investigated further.



LEGEND

- X₀ = Predictor variable at baseline (T0)
- X₁ = Predictor variable at follow-up (T1)
- M₀ = Mediator variable at baseline (T0)
- M₁ = Mediator variable at follow-up (T1)
- Y₀ = Outcome variable at baseline (T0)
- Y₁ = Outcome variable at follow-up (T1)

Path c_1' = direct effect

Path $a_1 * b_1$ = indirect effect (mediation pathway)

Fig. 2. Model for mediation analysis with two-wave longitudinal data (61, 62). [Colour figure can be viewed at wileyonlinelibrary.com]

Aim 2: Potential mediation models

Model 1 – distress model (ideation-to-attempt transition). As seen in Fig. 3, neither the direct effect of T0 auditory HEs ($b = 0.64$, $SE = 0.72$, $P = 0.37$; $OR = 1.90$, $95\%CI = 0.46–7.79$) nor indirect effect of psychological distress ($b = 0.74$, $SE = 0.67$, $P = 0.27$) was significantly associated with suicide attempts at 1-year follow-up. The only significant pathway in this model was the direct effect of T0 psychological distress on future suicide attempts ($b = 1.41$, $SE = 0.69$, $P = 0.04$; $OR = 4.09$, $95\%CI = 1.07–15.68$).

Model 2 – theoretical or IPTS model (ideation-to-attempt transition). The three-way interaction term (perceived burden \times thwarted belonging \times acquired capability) is predicted by the IPTS theory to have the strongest effect on suicide attempts (22). However, in the current three-way model (see Fig. S1), no baseline or follow-up variable was significantly associated with incident suicide attempts. Additional analyses with each individual IPTS construct as the mediating variable were conducted, including each main effect and two-way interaction. No significant results were found with respect to incident suicide attempts, except for the two-way interaction between acquired capability and perceived burdensome (Fig. 4). As seen in Fig. 4, auditory HEs did not have a significant direct effect on suicide attempts at 1-year follow-up in this model ($b = 0.44$, $SE = 0.71$, $P = 0.53$; $OR = 1.56$, $95\%CI = 0.38–6.31$). The indirect effect of the acquired capability \times perceived burden interaction was also non-significant ($b = -0.35$, $SE = 0.37$, $P = 0.34$). The only significant pathway in this model was the direct effect of the two-way (acquired capability \times perceived burden) interaction at T1 (not T0) on incident suicide attempts ($b = 0.10$, $SE = 0.04$, $P = 0.02$; $OR = 1.09$, $95\%CI = 1.01–1.17$). Post hoc exploration of the interaction indicated that the association between perceived burden and incident suicide attempts was only significant at the highest level of acquired capability for suicide.

Based on AIC and BIC criteria, this theoretical model (AIC = 3343.38; BIC = 3431.14) was not a better fit overall for the data than the distress model (AIC = 1068.39; BIC = 1142.65), $\chi^2(1) = 2266.99$, $P = 1.00$. An additional model examined the effects of IPTS theoretical constructs on incident suicide attempts, but also included the effects of psychological distress (data not shown). With psychological distress included, the suicide attempt model was essentially unchanged with non-significant direct and indirect pathways between baseline auditory HEs and incident suicide attempts.

Aim 3: Potential moderation or interaction effect

As seen in Table 1, the grouped logistic regression found those with auditory HEs only at baseline were not at significantly increased risk of transition from suicidal ideation to attempts. Similarly, adolescents with psychological distress only (i.e. at or above GHQ-12 clinical cut-off at baseline) did not have a significant increase in transition from ideation to attempts; although there were wide confidence intervals around both of these estimates. Adolescents who reported both distress and auditory HEs had a nine-fold increased risk of acting on their suicidal thoughts.

Discussion

This was the first study, to our knowledge, to investigate the role of PEs in the suicidal ideation-to-attempt transition using a prospective longitudinal dataset. Our study fills an important gap in the wider literature examining the ideation-to-attempt transition, by allowing for the temporal lag between suicidal thoughts and subsequent suicidal behaviours. Few studies have explored factors that predict the progression from suicidal ideation to attempts over time (17, 18). The current study also addresses gaps in the broader literature on the explanatory role of the IPTS theory. This was the first study to incorporate a longitudinal community sample of adolescents to investigate all three IPTS theoretical constructs (thwarted belonging, perceived burden and acquired capability) in the ideation-to-attempt transition. It is uncommon for studies to incorporate all three IPTS constructs, let alone within a longitudinal design (24, 66).

Among adolescents reporting baseline suicidal ideation ($n = 216$), 6.5% attempted suicide at 1-year follow-up. Baseline auditory HEs were not significantly associated with the transition from suicidal ideation to attempts. This finding was consistent with previous cross-sectional studies (27) which found PEs did not make an additional contribution to suicide attempts among those with suicidal ideation. Even though the total effect of auditory HEs on incident suicide attempts was not significant, over a third of adolescents who transitioned reported auditory HEs at baseline. Also, the univariate odds ratio for this association was relatively high ($OR = 2.40$), with confidence intervals ranging from just below 1 to 7.56, and therefore the non-significant association may reflect low statistical power and a type II error, attributable to the relatively small subsample of adolescents reporting suicidal ideation at baseline, and among

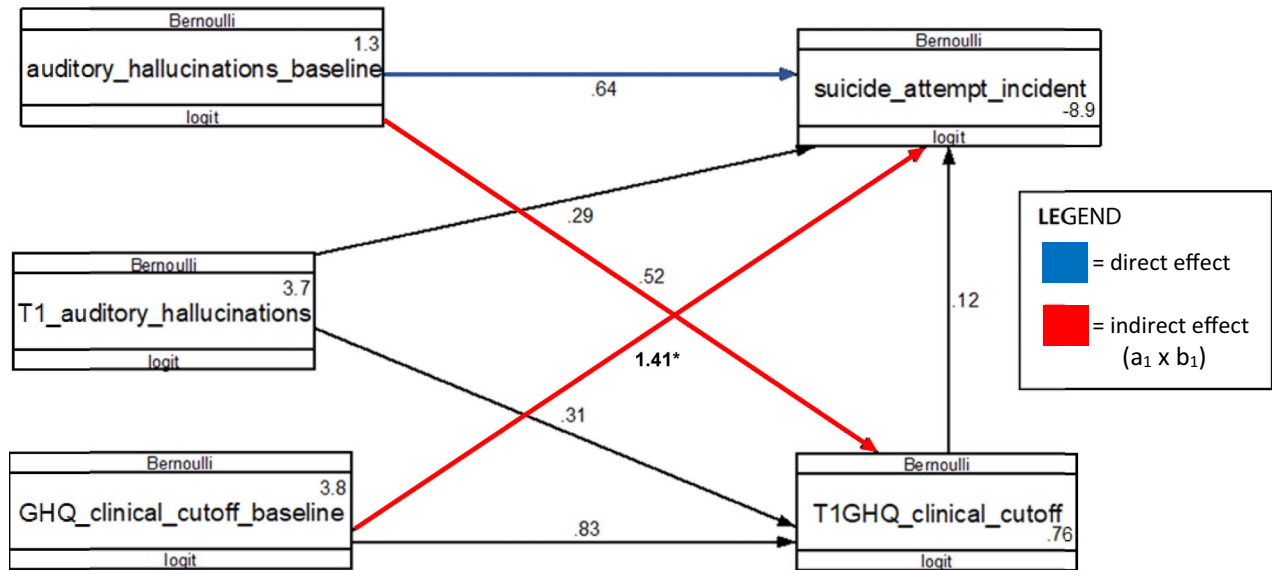


Fig. 3. Distress model of the association between baseline auditory hallucinatory experiences, psychological distress (GHQ-12) and incident suicide attempts among those endorsing suicidal ideation ($n = 216$). Note. Unstandardized effects are reported; * $P < 0.05$; T0 = baseline, T1 = follow-up; GHQ-12 = General Health Questionnaire-12. Psychological distress = equal to or above GHQ-12 clinical cut-off score. Score of >13 for males, and >18 for females. [Colour figure can be viewed at wileyonlinelibrary.com]

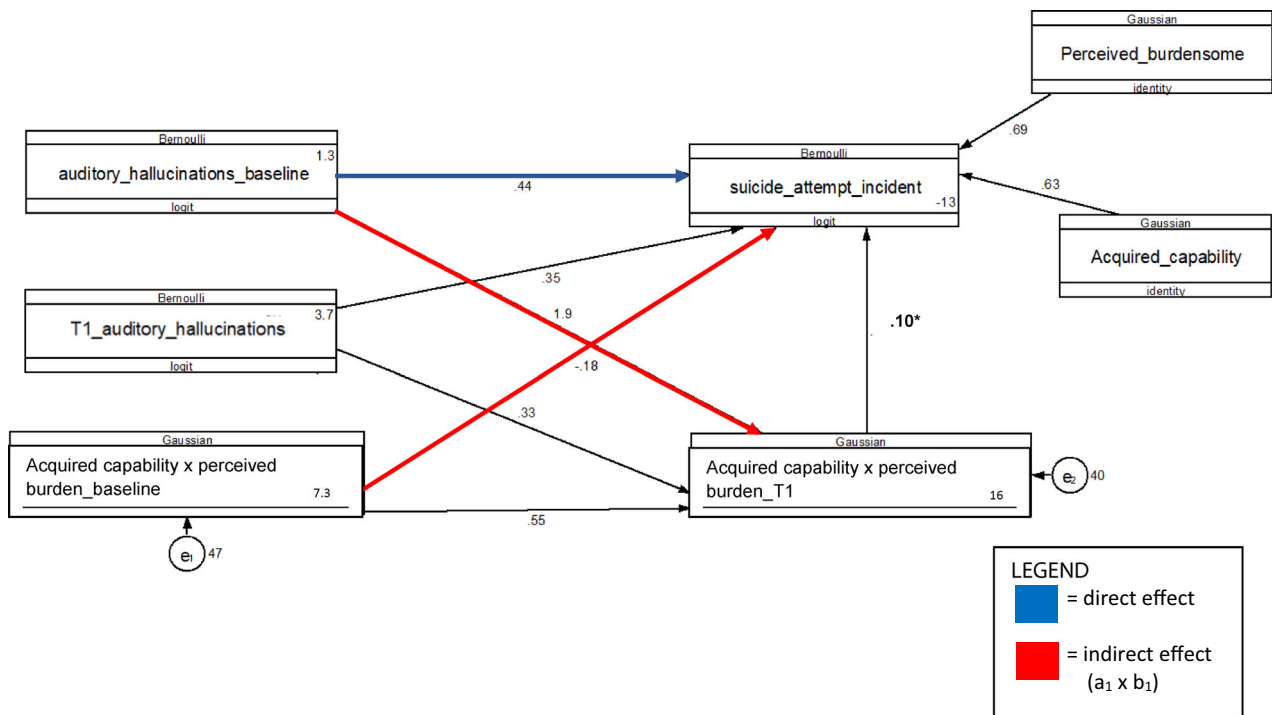


Fig. 4. IPTS two-way (acquired capability × perceived burden) interaction model of the association between baseline auditory hallucinatory experiences and incident suicide attempts among those endorsing suicidal ideation ($n = 216$). Note. Unstandardized effects are reported; * $P < 0.05$; T0 = baseline, T1 = follow-up; IPTS = Interpersonal Theory of Suicide. [Colour figure can be viewed at wileyonlinelibrary.com]

those, the low number who attempted suicide. In the total sample ($n = 1669$), auditory HEs were significantly and independently associated with both baseline suicidal ideation and future suicide attempts. Follow-up longitudinal studies are

warranted using larger, high-risk samples with a higher prevalence of suicidal behaviours.

Neither distress nor theoretical models significantly mediated the association between baseline auditory HEs and the ideation-to-attempt

Hallucinatory experiences and suicide attempts

Table 1. Participants with suicidal ideation who attempted suicide one year later, stratified by auditory hallucinatory experiences and psychological distress ($n = 216$)

AHE/PD grouping	Incident attempted suicide at 1-year follow-up					
	Yes ($n = 14$)		No ($n = 202$)		OR†	95%CI
	<i>N</i>	%	<i>N</i>	%		
No AHEs, No PD‡	2	2.2	91	97.8	(ref)	(ref)
AHE alone	1	5.9	16	94.1	3.38	[0.28, 40.46]
PD‡ alone	7	8.7	73	91.3	4.88	[0.98, 24.46]
AHE and PD‡	4	15.4	22	84.6	9.58*	[1.61, 56.98]

95%CI; 95% confidence interval; AHEs, auditory hallucinatory experiences at baseline; OR, odds ratio; PD, psychological distress at baseline as measured using the General Health Questionnaire-12 (GHQ-12).

* $P < 0.05$.

†Odds ratio adjusted for age and sex.

‡Psychological distress = equal to or above GHQ-12 clinical cut-off score. Score of ≥ 13 for males, and ≥ 18 for females.

transition. Therefore, in the current study, auditory HEs were not significantly associated with the transition from suicidal thoughts to behaviours, either directly or indirectly – *except* when interacting with distress (see below). Nevertheless, the mediation models had some notable findings. For adolescents with baseline suicidal ideation, psychological distress (at baseline) was associated with incident suicide attempts at 1-year follow-up. This finding has face validity and is consistent with previous studies showing psychological distress as a significant and independent predictor of suicidal ideation and attempt outcomes (6, 11, 35). There was little support for the IPTS theory in the mediation models. The only significant finding was the concurrent association between the two-way (acquired capability \times perceived burden) interaction and incident suicide attempts (where the perceived burden-attempt association was significant at only the highest level of acquired capability), with an odds ratio just above one. The IPTS main effects at baseline and follow-up were not associated with incident suicide attempts. Further, the core prediction of the theory (i.e. the significant three-way interaction effect on suicide attempts) was not supported. Cxyz et al. (58) reported similar results with adolescent inpatients followed after hospital discharge, where the baseline three-way IPTS interaction did not predict suicide attempts at 1-year follow-up.

Auditory HEs appear to strengthen the effect of baseline psychological distress on incident suicide attempts, or vice versa, although it was distress (and not auditory HEs) that was independently associated with attempt transition. Adolescents who reported both psychological distress and auditory HEs had a nine-fold increased risk of acting on their suicidal thoughts (see Table 1). This suggests that auditory HEs may act as a moderator in the association between psychological distress and

the ideation-to-attempt transition. We recommend caution when interpreting these results, given small cell sizes in Table 1. Also, even though non-significant findings were reported for the effects of auditory HEs and psychological distress alone, the size of odds ratios (and width of corresponding confidence intervals) suggest there may well be a significant relationship between incident suicide attempts and both of these variables individually, but that the analyses were underpowered.

Strengths and limitations

Strengths. A key strength of the study was the longitudinal design allowing for the temporal lag between suicidal thoughts and behaviours; although the temporal relationship between auditory HEs and suicidal ideation was less clear (we assumed a relationship between suicidal ideation to auditory HEs to suicide attempts, but it is possible auditory HEs in fact preceded suicidal ideation (67)). Previous research on the ideation-to-attempt transition has been largely cross-sectional and retrospective reporting, of both risk factors and suicidal outcomes, where the temporal direction of associations (particularly between suicidal thoughts and behaviours) is unclear (17). The present study was the first to investigate the complete IPTS theory in a longitudinal community sample of adolescents. Several studies (15, 66) have tested the IPTS theory longitudinally among young people but have either incorporated a clinical sample (58) or have only focused on the first half of the theory, that is the transition from passive to active suicidal ideation (68–70). In addition, our study used an innovative statistical approach by incorporating MacKinnon et al.'s two-wave mediation approach (61), and by incorporating and comparing models informed by both theory and data from epidemiological studies. Collectively, these

statistical approaches could be used as a template for examining distal and proximal predictors of the ideation-to-attempt transition in future studies.

Limitations. Current findings must be interpreted in light of several limitations. There was a high rate of non-response from parents who did not return consent forms for their children. While this may affect generalisability to this sampling frame, we believe it did not affect main within-subjects analyses. Generalisability is further limited by the lack of government schools (approximately 74% of Australian schools). Our sample, drawn largely from Catholic schools, may consist of adolescents from families with parents more engaged in their children's lives, and possibly better educated and socioeconomically advantaged. Given the association between psychological distress and SES disadvantage, our prevalence of mental health problems/suicidality may be an underestimate compared with the wider Australian community. Further, religious affiliation may be protective against suicide.

Our study, like other longitudinal studies, experienced attrition. Of note, those who were older, reported psychological distress and suicidal ideation at baseline were more likely to be lost to follow-up. Loss of adolescents reporting any one of these variables would have likely resulted in underreporting of the true incidence of suicide attempts between baseline and 1-year follow-up; considering older adolescents (16–17 years) have a greater likelihood of engaging in suicide attempts than younger adolescents (12–15 years) (71), and suicidal ideation and distress are both strongly associated with increased risk of future suicidal behaviour (35). There was some evidence of underreporting, where the current estimate (of 1.4% reported suicide attempt at 1-year follow-up) is lower than those from a nationally representative survey of Australian adolescents (71) which reported a 12-month prevalence of suicide attempts of 2.4% in adolescents (12–17 years). In terms of the potential impact on the relationship of interest (HEs and attempt transition), a previous analysis (72) using a longitudinal cohort study (≥ 5 year, with $\geq 30\%$ attrition) found differential loss to follow-up has minimal impact on the strength or direction of an association, and, instead, largely impacts the precision of association estimates.

The large overall sample is a notable strength of the study, although the present analysis mainly involved a relatively small subset of those individuals ($n = 216$), of which very few reported an incident suicide attempt at follow-up. Suicide attempt

is a rare event and there are statistical limitations such as a lack of variance in the outcome measure. Few studies are designed with these transition-type questions in mind, and studies are typically insufficiently powered to examine the ideation-to-attempt transition over time (73).

In terms of measurement limitations, suicidal ideation was only captured using one item which can lead to misclassification of about 8.8% of respondents (74). Proxy measures were used to capture IPTS latent constructs of perceived burdensomeness, thwarted belongingness and acquired capability for suicide. While RFL-A and MSPSS (subscales) indicators were assessed to adequately represent their respective latent variable (see Appendices S1 and S2), the current findings need to be confirmed using scales like the INQ (75). Both perceived burdensomeness and thwarted belongingness are considered cognitive states that vary across time and situations (22), whereas acquired capability is considered to be relatively stable (76). The current study's annual data collection may not have been the most appropriate to capture the dynamic components of the IPTS theory. Finally, all key variables used in the study were self-reported and thus are prone to recall bias.

Future research and clinical implications

Considering the size of auditory HEs' univariate odds ratio in the ideation-to-attempt transition, further studies are required using larger, more representative samples of adolescents. Development of robust risk factors suitable for clinical use to predict subsequent suicidal behaviour may hinge on examining shorter time frames within high-risk samples (73). Future research should endeavour to capture the dynamic nature of suicidal phenomena and theoretical constructs (e.g. perceived burdensomeness and thwarted belongingness) in longitudinal datasets with shorter time frames or Ecological Momentary Assessment study designs (i.e. daily diaries), as well as increase clarity on the nature of the temporal relationship between auditory HEs and suicidal ideation (particularly when investigating HE's role in the ideation-to-attempt transition).

Our findings suggest adolescents with suicidal ideation who go on to attempt suicide are more likely to be highly distressed. When accompanied by auditory HEs, there is a nine-fold increased risk of adolescents acting on suicidal thoughts. Importantly, this is a nine-fold increased risk relative to adolescents with suicidal thoughts only (as opposed to a reference group of adolescents with

no suicide attempts, irrespective of suicidal ideation). Therefore, this group of adolescents (reporting ideation + distress + auditory HEs) constitute a high-risk group for suicide attempts for whom identification and appropriate safety planning is essential. Also, further investigations on the role of negative and distressing content of hallucinations in the ideation-to-attempt transition are warranted.

To conclude, auditory HEs were not significantly associated with the transition from suicidal thoughts to behaviours, either directly or indirectly, although this null finding needs confirmation in larger, high-risk samples. The presence of auditory HEs appears to strengthen the effect of baseline distress on incident suicide attempts. Distress caused by HEs interaction deserves greater attention in future research. Studies should also continue to be informed by both data-driven and theoretical frameworks to further advance our understanding of the mechanisms that increase subsequent suicide risk in young people.

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Conflict of interest

The authors declare no conflicts of interest.

Data availability statement

Data available from the first author upon request.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. IPTS three-way interaction model of the association between baseline (or T0) auditory hallucinatory experiences and incident suicide attempts among those endorsing suicidal ideation ($n = 216$), with the underlying latent structures.

Appendix S1. Measures of IPTS constructs.

Appendix S2. Additional information on data and analyses.

Appendix S3. Association between auditory hallucinatory experiences (HEs), suicidal thoughts/behaviours, and third variables in entire sample ($n = 1669$).