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Can drawings facilitate symbolic understanding of figurative language in children?

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Figurative expressions such as metaphors and idioms contain meaning that differs from their literal interpretation (Lakoff & Johnson, 2008). To correctly understand expression ‘she had a heart of stone’, for instance, one must understand that the person does not literally have a stone heart, but is callous. It has been estimated that we use roughly 50 metaphors per thousand words of speech (Cameron, 2008), and approximately six non-literal expressions per minute of discourse (Pollio, Barlow, Fine, & Pollio, 1977). By adulthood, people are using approximately 2.9 non-literal expressions per each sent email (Whalen et al, 2009), indicating the pervasiveness of figurative language into everyday life. Understanding figurative expressions comprises a critical component of successful conversation and has been shown to ease comprehension (Ackerman, 1982), affect thinking and reasoning on implicit levels (Thibodeau, Hendricks, & Boroditsky, 2017), and lay the foundation for the acquisition of socio-cultural norms (Cameron, 2007). It also links to successful school achievement (Nippold, 2016).

A developmental trend is generally seen in metaphor and figurative language understanding, whereby children show a marked increase in as they enter formal education (Katis & Selimis, 2005), which develops alongside other linguistic (Pouscoulous 2011, 2014) and cognitive competencies such as working memory capacity (Johnson 1989; Johnson & Pascual-Leone, 1989). Several other factors can facilitate figurative language understanding, including providing informative (Bosco, Vallana, & Bucciarelli, 2009). Levorato & Cacciari, 1999) and situational context (Pouscoulous, 2014; Vosniadou, 1989). Importantly, recent evidence suggests that the specific way that figurative language such as metaphor is tested can reveal different levels of performance (Kalandadze, Bambini, & Næss, 2019). For instance, young children show earlier proficiency when asked to act out a metaphor rather than explain it, likely due to reduced verbal and cognitive demands (Pouscoulous, 2011).

Differences have also been obtained in verbal tasks compared to multiple choice measures, with the latter placing fewer demands on children and more accurate responses in children with Autism Spectrum Disorder (Kalandadze, Bambini, & Næss, 2019).

One open question is whether drawings might be linked to understanding of figurative expressions, in particular, whether drawings can facilitate symbolic interpretations of such linguistic statements. There are several reasons one might expect a putative relation. First, both figurative expressions and drawings represent symbolic and conceptual information, where the expression (Gibbs, 2008; Ortony & Andrew, 1993) or drawing (DeLoache, 2004) acts as a symbol for something else. Several authors have raised the possibility symbolic knowledge across different domains share a common source early in development (Allen, Mattock, & Silva, 2014; Kirkham, Stewart & Kidd, 2013), and thus may be related. Secondly, metaphor tasks using picture-based stories have revealed good levels of comprehension due to potential cross-modal processing (Rundblad & Annaz, 2010a; b). Finally, and perhaps most interestingly, the act of drawing has been repeatedly shown to relate to an increase in verbal recall in both children and adults after witnessing a live event (Butler, Gross & Hayne, 1995), watching a video (Barlow, Jolley, & Hallam, 2011) or when recalling emotionally powerful experiences (Gross & Hayne, 1998; Wesson & Salmon, 2001).

In a seminal study by Butler, Gross & Hayne (1995), 5-6-year olds participated in a unique event and were interviewed the next day about their experience. They were asked to draw what happened or simply tell what happened. The group who drew reported more accurate and detailed information in verbal explanations compared to those who just verbally reported events, even after a one-month delay. Similar work has shown that drawing can facilitate recall even after a year-long delay (Gross & Hayne, 1999, but see Salmon & Pipe, 2000). The authors suggested that drawing allows children to generate their own retrieval cues, which then enables them to provide a greater amount of information. Interestingly, the

drawings in these and other similar studies were not scored for content beyond representational quality (e.g. whether the drawings are relatively faithful depictions of what they are meant to be of), so a comparison between what was drawn and what was said could not be conducted (but see Iordanou, Allen & Warmelink, under review). It is possible that children find it easier to display their conceptual knowledge graphically compared to verbally as it removes conversational constraints (Jolley, 2010), and that may be particularly true for younger participants (Pouscoulous, 2011).

Drawings tend to elicit script-based knowledge (Jolley, 2010) unless tied to a particular aspect of an event (Salmon & Pipe, 2000). It is unknown whether drawings help retrieve semantic, lexicalised information in the same way that they facilitate episodic, event-based, information. One study suggests a potential link; Farias and colleagues (2006) found a relation between drawing and naming in aphasic patients. In this population, the process of drawing an object facilitated the name of the object, whereas writing the word diminished accurate naming responses. Based on these findings and prior research that has shown a conceptual association between drawing and language (Gainotti, Silveri, Villa, & Caltagirone, 1983; Kirk and Kertesz, 1989; Swindell, Holland, Fromm, & Greenhouse, 1988) these researchers hypothesized that drawing may access the semantic system in a manner different from writing, thereby improving naming. This suggests that some core aspects of language might be successfully accessed when drawings are used as a retrieval cue.

Another possibility is that the act of drawing figurative statements may prolong the interaction between child and adult (Butler, Gross & Hayne, 1995), allowing more time to inhibit a literal response and retrieve a symbolic one. Indeed, classic accounts of metaphorical understanding posit that literal interpretations are default interpretations that initially arise, before figurative explanations are retrieved (Glucksberg, 2003; Glucksberg & Keysar, 1993; Stern, 2000). If this account is correct, drawing before verbally explaining

figurative statements should facilitate subsequent symbolic explanations, but there should be no advantage if verbally explaining statements precedes drawing them.

Children begin to produce representational drawings by age 4 (Vinter, 1999), as initial scribbles give way to an understanding of representational insight with adult interaction and scaffolding (Luquet, 1927/2001). Luquet's influential theory of drawing development centres on the notion of realism, as children progress through particular stages that shape their conceptual understanding and types of expressions until they achieve visual realism. In free expressive drawing, there appears to be a developmental progression from drawing literal to metaphorical expression from ages 5-11 (Picard & Gauthier, 2012), however it should be noted that diverse educational and cultural factors (such as a Steiner approach) can result in different trajectories and individual variation (Cox & Rowlands, 2000; Rose, Jolley & Charman, 2012). In their study, Picard & Gauthier (2012) classified drawings from 480 children and adolescents as literal (expressive drawings that included facial features), metaphorical and literal combined (expressive drawings that combined facial expression cues with abstract and/or content cues), or just metaphorical (expressive drawings that featured abstract and/or content cues). Other studies investigating metaphorical expression have characterised it in terms of size, mood or colour (Picard & Lebaz, 2010; Jolley & Thomas, 1995). Jolley (2010) argues that we may understand content and abstract expression of drawings in the same way we understand linguistic metaphors (see Thomas & Jolley, 1997), however no studies have looked at metaphorical *content* rather than *expression*. Our study is therefore the first to directly investigate a developmental trajectory of metaphorical content in drawings.

The central aim of our study is to ascertain whether drawings can facilitate the symbolic interpretation of figurative expressions. As metaphor understanding is not an all or nothing phenomenon (Norbury, 2005), some variability in understanding might be seen across expression tropes and across ages. We also wished to see if our figurative statements

related to more general metaphorical knowledge. To test this, we selected Norbury's (2005) metaphor task, adapted from Happé's (1995), original (Happé, 1993) measure, which asks participants to select from a choice of 4 responses for sentences containing metaphors or synonyms. In this way we could also compare our verbal explanation measure with performance on a multiple-choice task, since this has been argued to affect task performance (Kalandadze, Bambini, & Næss, 2019).

We selected three age groups for comparison: 5-6-year-olds, 7-8-year-olds and 9-10-year-olds. These groups were included to provide enough variability to chart a trajectory during a period of development where metaphorical and figurative language comprehension has been shown to increase (Van Herwegen, Dimitriou, & Rundblad, 2013; Rundblad & Annaz, 2010b). Children aged 3-4 show very limited understanding of figurative expressions (Katis & Seilmis, 2005), and those 11 and above have been noted to demonstrate a mature competency, with a peak before adolescence (Vulchanova, Vulchanov, & Stankova, 2011) (but see Nippold & Rudzinski, 1993 for evidence of mature competency in later adolescence). There is some controversy as to when precisely metaphorical and figurative knowledge comes online, with some researchers arguing for a later acquisition (i.e. age 7 and beyond) (Winner, 1997), yet others suggesting earlier knowledge (i.e. by 4-5 years) might be revealed under certain conditions (Ozcaliskan, 2002). Hence a range of 5-10 provides the opportunity to chart a developmental trajectory, provide ample variability while avoiding ceiling and floor effects, and inform the debate about early vs later comprehension using a drawing task. Although we predicted age related changes, we did not make specific a-priori predictions regarding the onset of figurative knowledge. Overall, our study can inform the relationship between drawing and comprehension of figurative statements in a developmental context.

Method

Participants

Ninety-six typically developing, native English-speaking children aged 5-10 ($M=95.47$ months, range = 66-129 months) participated in the study. The sample comprised 47 males and 49 females who were split into three age groups ($N=32$ in each; 5-6 year-olds (mean 72.5 months, $SD = 4.9$), 7-8 year-olds (mean = 92.3 months, $SD = 3.8$) and 9-10 year-olds (mean 121.6 months, $SD = 5.1$). Children were tested in a quiet location at a primary school in Preston, UK. All children in the school within the age range of 5-10 years were invited to participate; children whose parents provided informed consent were subsequently tested.

Materials

Children were given sheets of A4 white paper presented in landscape orientation, a range of coloring pencils, a graphite pencil, and an eraser.

Procedure

The design was between-subjects, with age group and condition as independent variables. Half of each age group was randomly assigned to a 'Draw First' or 'Explain First' condition. Each participant was asked to both verbally explain and draw 4 figurative statements, selected for their ability to be depicted graphically after pilot testing: The river was a snake; He had a heart of stone; It's raining cats and dogs; and He was feeling blue. The statements were counterbalanced to prevent order effects. After this the children were given a metaphor task (Norbury, 2005) to assess word knowledge and fundamental understanding of metaphors; see Appendix A1 and A2 for examples.

Draw First. In this condition, children were verbally told each figurative statement and first asked to draw what they thought it meant to them. Following each drawing, children were then asked to verbally explain the statement (i.e. "Can you now explain what you think X means?").

Explain First. In this condition children were verbally told each figurative statement and first asked to explain it, and then to draw it.

Coding: Verbal Explanations and Drawings. All of the children's responses were audiotaped to enable offline double coding for symbolic or literal understanding. The coding was done by two independent raters who were blind to the hypotheses; both were volunteers. Coders were provided with initial examples of stimuli and the second author explained that their task was to ascertain which category each drawing and explanation belonged. Categories for verbal explanations and drawings included: symbolic, literal, both, or other. In order for a drawing or explanation to be classed as *symbolic*, the child must have verbally explained or graphically depicted the true meaning of the statement. For example, a symbolic explanation of 'It's raining cats and dogs', would refer to or depict heavy rain with no reference to cats or dogs. A statement classed as *literal* would refer to or graphically depict the literal rather than symbolic meaning (e.g. cats and dogs falling down from the sky). If children provided both symbolic and literal responses (e.g. depicting or describing rain *and* cats and dogs), this was coded as *both* (see Figure 1 for sample drawings). All other responses were coded as *other* (see Appendix B1 and B2 for full coding sheets).

We analysed responses in three ways. First, symbolic responses were summed across the statements to provide a maximum score of 4. As we had four different content categories, we also summed the literal responses (maximum score = 4) as these were also of interest and not mutually exclusive of the symbolic responses. We also compared the individual statements to each other to assess item effects.

[INSERT FIGURE 1 ABOUT HERE]

Results

Reliability

Cohen's Kappa analysis was conducted to check for inter-rater reliability between the two coders on all of the drawings and explanations of the figurative statements. The kappa values for all metaphor tasks (drawing and explaining) ranged from $k=.881$ to $k=.968$ with significant values for $p<.005$, which indicates very high agreement. For the analysis, the first rater's scores were used.

Symbolic Responses

A mixed ANOVA with symbolic responses between response type (drawings and verbal explanations) as the within factor and age and condition (draw first and explain first) as the between factors was conducted. Children's *explanations* ($M=1.72$, $SD=1.51$) of figurative statements were significantly more symbolic than their *drawings* ($M=1.47$, $SD=1.52$) $F(1,90)=25.56$, $p<.001$, $\eta_p^2=.221$. We also found a main effect of condition $F(1,90)=4.23$, $p=.043$, $\eta_p^2=.045$, demonstrating that children who drew first ($M=1.79$, $SD=1.42$) provided more symbolic responses than those who explained first ($M=1.39$, $SD=1.57$). Finally, we found a main effect of age group $F(2,90)=70.49$, $p<.001$, $\eta_p^2=.610$, with Tukey tests confirming that 9-10 year olds ($M=3.2$, $SD=.85$) provided more symbolic responses than 7-8 year olds ($p<.001$; $M=1.17$, $SD=1.3$) and 5-6 year olds ($p<.001$; $M=.45$, $SD=.70$). The 5-6 year-old and 7-8 year-old groups also significantly differed from each other ($p=.003$).

We also found a significant interaction between response type and condition $F(1,90)=25.56$, $p<.001$, $\eta_p^2=.221$. Paired t-tests revealed no significant difference in response type in the explain first condition (verbal explanations $M=1.40$, $SD=1.57$; drawings $M=1.38$, $SD=1.42$), but a significant difference in the draw first condition $t(47)=5.10$, $p<.001$, with a greater number of symbolic responses provided in verbal explanations ($M=2.04$, $SD=1.40$) compared to drawings ($M=1.54$, $SD=1.47$).

We ran additional paired comparisons to test for within modality differences. We found that symbolic graphical responses were equivalent in both conditions $t(94)=-.47, p =.392$, but symbolic verbal explanations were greater in the draw-first compared to the explain-first condition $t(94)=2.13, p <.036$.

Literal Responses

We also ran a mixed ANOVA with literal responses between response type (drawings and verbal explanations) as the within factor and age and condition (draw first and explain first) as the between factors. Children's *drawings* ($M=1.52, SD=1.20$) of figurative statements were significantly more literal than their *explanations* ($M=1.41, SE=1.24$), $F(1,90)=7.65, p=.007, \eta_p^2=.078$. We also found a main effect of condition $F(1,90)=5.28, p=.024, \eta_p^2=.055$, demonstrating that children who explained first ($M=1.67, SD=1.24$) provided more literal responses than those who drew first ($M=1.38, SD=1.16$). Finally, we found a main effect of age group $F(2,90)=31.46, p<.001, \eta_p^2=.411$, with Tukey tests confirming that 9-10 year olds ($M=.406, SD=.62$) provided fewer literal responses than 7-8 year olds ($p<.001; M=1.9, SD=1.1$) and 5-6 year olds ($p<.001; M=2.1, SD=1.0$). The 5-6 year-old and 7-8 year-old groups did not significantly differ from each other ($p=.424$).

We also found a significant interaction between response type and condition $F(1,90)=15.00, p<.001, \eta_p^2=.143$. Paired t-tests revealed no significant difference in response type in the explain first condition (drawings $M=1.67, SD=1.24$; verbal explanations $M=1.71, SD=1.29$), but a significant difference in the draw first condition $t(48)=3.69, p =.001$, with a greater number of literal responses provided in drawings ($M=1.37, SD=1.32$) compared to verbal explanations ($M=1.12, SD=1.16$). We note that overall symbolic verbal explanations in the draw first condition have a higher mean than any other task by condition combination.

We ran additional paired comparisons to test for within modality differences. Literal graphical responses were equivalent in both conditions $t(94)=-1.18, p =.392$, but literal verbal

explanations were greater in the explain-first compared to the draw-first condition $t(94)=2.13$, $p < .036$.

Individual Figurative Expression Analysis

To ascertain potential differences between figurative expressions, we ran two Friedman's tests. There was no significant difference in symbolic interpretations for the verbal explanations ($\chi^2(3)=4.6$, $p=.20$). However there was a significant difference in the drawing modality ($\chi^2(3)=11.3$, $p=.01$), suggesting that children found some statements more difficult than others to depict symbolically; a check of the descriptive information suggests that the metaphor 'heart of stone' produced the fewest symbolic responses overall. See Table 1 (drawings) and Table 2 (verbal explanations) for individual response types.

[INSERT TABLE 1 ABOUT HERE]

[INSERT TABLE 2 ABOUT HERE]

Metaphor Task (Norbury, 2005)

A one-way ANOVA was conducted using age-group as the between-subjects factor to investigate a developmental progression of metaphorical knowledge. In the modified task children were shown 5 synonym questions (scored out of 5) and 5 metaphor questions (scored out of 5). The means and standard deviations for the synonym questions were: 5-6-years ($M=1.88$, $SD=1.24$), 7-8-years ($M=2.44$, $SD=1.01$), and 9-10-years ($M=3.75$, $SD=1.08$). The means and standard deviations for the metaphor questions were: 5-6-years ($M=3.44$, $SD=1.50$), 7-8-years ($M=4.38$, $SD=1.18$), and 9-10-years ($M=4.63$, $SD=.71$). Surprisingly, synonym questions ($M=2.69$, $SD=1.36$) were more difficult than metaphor questions ($M=4.15$, $SD=1.27$), $t(95)=9.27$, $p < .001$; this may relate to theory of mind ability (Norbury, 2005) but we did not directly assess this possibility.

There was significant age difference for the synonym questions $F(2,93)=23.88$, $p<.005$, $\eta_p^2=.339$; post-hoc tests using Bonferroni revealed differences between the 9-10 year-olds and 5-6 and 7-8 year old groups (both $p<.001$). There was also a significant age difference for the metaphor questions $F(2,93)=9.05$, $p<.005$, $\eta_p^2=.163$, across all age groups (all post-hoc comparisons $p<.01$).

Performance on the metaphor questions of this task related to symbolic drawing ($r=.518$, $N=96$, $p<.001$), and symbolic verbal responses ($r=.516$, $N=96$, $p<.001$) on our behavioural task. When partial correlations controlled for age, however, these effects disappeared ($r=.118$, $N=96$, $p=.254$ for drawings and ($r=.072$, $N=96$, $p=.490$ for verbal explanations), suggesting that chronological age is driving task performance. Similar results were obtained for the synonym questions; performance on these related to symbolic drawing ($r=.357$, $N=96$, $p<.001$), and symbolic verbal responses ($r=.355$, $N=96$, $p<.001$) on the behavioural task. When partial correlations controlled for age, however, these effects disappeared ($r=.085$, $N=96$, $p=.412$ for drawings and $r=.032$, $N=96$, $p=.760$ for verbal explanations).

Discussion

This study investigated whether drawing figurative expressions would facilitate symbolic verbal explanations, and whether children would produce more symbolic content in their drawings relative to verbal statements. We also explored a developmental trajectory across 3 age groups (5-6, 7-8, and 9-10 years of age). We found that drawing before explaining statements led to an increase in symbolic responses in the verbal domain, and that overall children produced more symbolic explanations in their statements relative to symbolic depictions within the drawings themselves. There was also a clear linear progression of ability with increasing age. We discuss these findings in turn.

When all groups of children were asked to graphically depict the figurative statements prior to verbally explaining them, they were more likely to produce a symbolic verbal explanation when asked what each statement meant, compared with a condition in which children explained the statements *before* drawing them. Several factors may explain this finding. First, the act of drawing can reduce conversational constraints associated with interview type situations in which children are asked to respond to the verbal requests of a relatively unfamiliar examiner (Jolley, 2010), making them more at ease (Butler et al., 1995). Drawing also tends to lengthen the time of verbal interviews; both of these factors may have given children more time to inhibit a literal interpretation of the figurative statements and retrieve a symbolic one. As mentioned in the introduction, according to classic accounts of metaphorical understanding, literal interpretations are default and retrieved prior to figurative explanations (Glucksberg, 2003; Glucksberg & Keysar, 1993; Stern, 2000). The development of executive function and inhibition (Müller & Kerns, 2015) may thus play a role. Supporting this, Kasirer & Mashal (2016) found that executive function tasks explained a significant amount of variance in predicting conventional metaphor understanding by children, adolescents and adults with dyslexia; future work should test this directly using a drawing paradigm.

Executive function, including working memory (Panesi & Morra, 2016) and inhibition (Riggs, Jolley, & Simpson, 2013) is also related to drawing ability. Specifically, Panesi & Morra (2016) demonstrated that memory capacity and executive function related to young children's ability to draw a dog that was different from their drawing of a human, showing that flexibility in drawing relates to executive processes, even when age and drawing skill are controlled for. Thus, the relation between executive functioning, figurative language understanding, and drawing needs to be explored in tandem.

Drawing has also been suggested as a way for children to generate their own retrieval cues and structure verbal reports in testimony situations (Butler et al., 1995; Gross & Hayne,

1998; Wesson & Salmon, 2001). In our experimental situation we were asking children to reflect upon semantic knowledge rather than episodic events, which is a qualitatively different kind of task requiring different retrieval processes (Levine et al, 2002). In our case each of the statements could be interpreted in two possible ways: literally or symbolically. One hypothesis is that drawing may have acted as a cue for children to provide a more symbolic verbal interpretation of semantic knowledge due to a shared symbolic foundation. This parallels cases in which young children demonstrate dual representation by understanding or using drawings to symbolically refer to objects in the real world, rather than appreciating them as literal 3-D objects in and of themselves, although they possess both types of understanding (DeLoache & Burns, 1994; Preissler & Carey, 2004; Preissler & Bloom, 2008). In other studies, naming has been used a cue for children to interpret pictures symbolically rather than literally as objects, although they can see them as 2-D entities when they are not named (Preissler & Bloom, 2007; Hartley & Allen, 2014). However, we did not see a complementary activation of a pictorial code after initial symbolic verbal explanations (e.g. more symbolic explanations in drawings after children first explained the statements), hence it is unlikely that the shared symbolic source account (Allen, Mattock, & Silva, 2014; Kirkham, Stewart & Kidd, 2013) can explain our findings.

We also found differences between symbolic performance across different figurative expressions. The various statements may be in different stages of becoming conventionalised, which depends upon a shift from comparison between target and vehicle to a process of categorisation (Bowdle & Gentner, 2005). The fact that sometimes children's responses were coded as 'both', in which they combined literal and symbolic interpretations of the statement for both drawings and explanations supports the idea of a transition phase (Ligorio, Schwartz, D'Aprile, & Philhour, 2017). Differences may also be driven by planning and processing demands (Akshoomoff, & Stiles, 1995; Golomb, 1983; La Femina, Senese, Grossi, & Venuti, 2009) associated with graphically depicting the statements, which varied in transparency and

familiarity. Children may have sometimes reverted to depicting the literal expression as it was easier to depict, although they then explained the statements symbolically or provided a verbal response combining literal and symbolic aspects.

We did find a relation between symbolic performance on our task and understanding of metaphor on Norbury's (2005) multiple choice task; however, this relationship disappeared when chronological age was controlled for. Given the same relationship was found with synonym questions, it is likely that age is a proxy for more general language or vocabulary ability. We found a clear age effect in that the youngest cohort provided more literal and fewer symbolic responses overall, compared to the two older age groups. This is consistent with Levorato & Cacciari (1995) who found that young children were more literally inclined, whereas older children were more idiomatically oriented. Deckert, Schomoeger, Schaunig-Busch & Willinger (2019) identified chronological age as a significant predictor of metaphor identification and comprehension, and this was most pronounced between the range of 8-10 years.

Children tended to fare better at Norbury's (2005) task compared to our behavioural measure, with 9-10 year olds 93% correct, 7-8 year olds 88% correct and 5-6 year olds 69% correct in Norbury's multiple choice task. Children provided fewer symbolic responses in our explanation and drawing task (with both modalities combined: 9-10 year olds 80%, 7-8 year olds 29% and 5-6 year olds 9%). Specifically, the youngest two groups had much more difficulty depicting and explaining figurative statements compared to choosing a forced choice response. Of course, this may reflect the particular statements selected for both tasks, but might also be indicative of the extra processing and linguistic demands the explanation task requires (Kalandadze, Bambini, & Næss, 2019), and the relative ease of making a forced choice response from 4 answers compared to a recall based task (Loftus, 1971). Testing modality is thus important to consider when assessing figurative knowledge.

Of note is that even our oldest cohort were not at ceiling in terms of providing symbolic explanations in our task, so our results align with accounts that posit, and evidence that supports, figurative language understanding as a gradual process (Cain, Towse, & Knight, 2009; Levorato & Cacciari, 2002) rather than a step change. In addition to age, the understanding of metaphors and idioms is also related to transparency, familiarity and inference from context surrounding the expressions (Cain, Towse, & Knight, 2009; Hattouti, Gil & Laval, 2016). These factors were not the primary interest in our study, but interact with age and input to affect figurative language development.

Of course, our study has several limitations. We studied only a few figurative statements to make our task engaging and developmentally appropriate; however, this means we are only testing knowledge for these specific expressions and restricts our ability to generalise knowledge. We did not record duration of drawing and thus cannot say whether the length of the session contributed to children's response types. We also studied 3 metaphors and 1 idiom, which were piloted and selected based upon their ability to be depicted graphically, and in the case of the metaphors, that the target and vehicles would be familiar to children of all age groups. Future work should compare multiple instances of different figurative types in drawing conditions, such as metaphor, idiom, and metonymy, in order to provide a more comprehensive picture of how drawing might facilitate symbolic interpretations. Further, semantic knowledge clearly contributes to metaphorical understanding, but we did not directly test broad word knowledge beyond Norbury's (2005) task, so we can not speculate on individual differences and the effect this has on our particular expression types. Given the direct link between language and drawing ability (Colbert, 1984), children with greater representational drawing skills may show enhanced figurative understanding; explicit tests of representational ability are thus important. It is also possible that by fostering representational drawing ability one may influence individual language skills, which extend to figurative expressions.

Despite these limitations, our findings suggest that there is a link between drawings and figurative language processing. We also provide additional evidence that understanding of symbolic interpretations increases gradually over development. Our study also provides the first empirical evidence that drawing *facilitates* figurative language understanding in childhood.

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Table 1

Response types for Drawings by Age Group

	Symbolic	Literal	Both	Other
River was a snake				
5-6 years	3	13	7	9
7-8 years	12	0	8	2
9-10 years	28	0	4	0
Heart of stone				
5-6 years	0	21	0	11
7-8 years	3	20	0	9
9-10 years	21	6	0	5
Raining cats and dogs				
5-6 years	6	13	11	2
7-8 years	9	14	9	0
9-10 years	23	8	1	0
Feeling blue				
5-6 years	3	20	0	9
7-8 years	8	20	4	0
9-10 years	26	1	1	4

Table 2

Response Types for Verbal Explanations by Age Group

	Symbolic	Literal	Both	Other
River was a snake				
5-6 years	6	15	2	9
7-8 years	15	10	5	2
9-10 years	29	0	3	0
Heart of stone				
5-6 years	0	21	3	8
7-8 years	3	18	3	8
9-10 years	22	5	0	5
Raining cats and dogs				
5-6 years	7	13	10	2
7-8 years	13	13	6	0
9-10 years	26	6	0	0
Feeling blue				
5-6 years	5	18	0	9
7-8 years	12	17	3	0
9-10 years	27	0	1	4

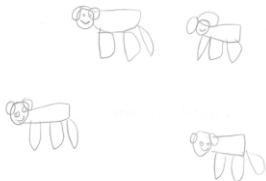




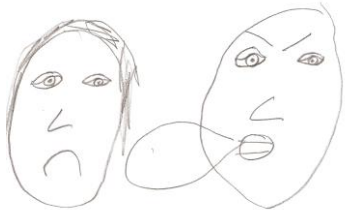






	5-6 years	7-8 years	9-10 years
It was raining cats and dogs			
He had a heart of stone			
The river was a snake			
He was feeling blue	 *note coloured in blue pencil		

Figure 1. Examples of drawings for each figurative expression across the 3 age groups.

Appendix A1

Example of item and foil choices. The correct answer is underlined.

Practice questions

The heating had been left on overnight and the room was very warm. It was:

synonym: hot a blanket a grill spicy

Simon had been walking in the snow for hours. His feet were:

metaphor: ice sweaty snowflakes shoes

Appendix A2

Sentence stimuli and synonym/metaphors used in metaphor task.

Sentence Stimuli	Synonym	Metaphor	Foil 1	Foil 2	Foil 3
The tree in my garden has grown a lot this year. It is	tall	a tower	a leaf	long	a castle
Mum left the bread out overnight. This morning it was	hard	a brick	milk	a pebble	hot
My school friend always protects me from bullies. He is	brave	a soldier	a bully	smart	broad
Laura talks so softly you can barely hear her. She is	quiet	a mouse	quick	a cat	a phone
Jen always gets good marks on her exams. She is	clever	a professor	a hand	a coach	a pen
Father was very cross when I got home late. He was	angry	a volcano	a mountain	a board	a clock
Our new school is very big and I always get lost. It is	confusing	a maze	a map	a string	a web
Joe spent too long in the swimming pool. He was	wrinkled	a prune	a ruby	a plum	a float
Kate had a lovely face and pretty eyes. She was	beautiful	a painting	a mirror	a statue	nosy
Robert was hiding behind the tree and not moving. He was	still	a statue	calm	a painting	a plant

Note. All of the sentences were structured in the same way as the practice questions in Appendix A.

Appendix B1
Coding sheet for drawings

	Its raining cats and dogs	He was feeling blue	He had a heart of stone	The river was a snake
Symbolic	-Heavy rain	-Man/woman crying -Sad person/sad face -Someone covering their face and crying	-Angry or mean person -Someone bullying another person and making them sad	-River that is shaped like a snake/curvy or wavy river
Literal	-Cats and dogs falling from the sky -Cats and dogs on the page	-Blue man/woman coloured in blue (light/dark) -Outline of a man/woman in blue -Smiling man/woman in blue	-A heart and then a stone next to it -A heart with a stone in it -A heart with jagged edges like a stone -A stone heart inside a person -A stone in the shape of a heart surrounded by other stones -Heart in a stone with a person smiling next to it -A stone with a heart in it	-Drawn a river with a snake in or on top of it -Snake/snakes in the water -Snake/snakes in the river
Both	-Rain and cats and dogs falling from the sky	-Blue face but sad -Blue person but sad	-Drawn someone shouting at someone else and being mean and drawn a heart made out of stone inside the person	-Curvy river like a snake but drawn a snake face at one end of the river
Other	-Swimming pool -House	-Blue blob Man/woman happy but crying Drawn a crocodile -A snake -A snowman -Grass and water -Someone not	-Half a heart -Stones -Only heart -Normal heart in a person -Grey hearts in a bed -Person with a	-Only a snake -Random shapes -A crocodile -A fish

		knowing what to do -Smiling man/woman (not in blue)	heart in them and a stone on the floor next to them -Cakes -Snake with circle shapes above it -Person in bed ill	
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Appendix B2
Coding sheet for verbal explanations

	It's raining cats and dogs	He was feeling blue	He had a heart of stone	The river was a snake
Symbolic	<ul style="list-style-type: none"> -Spoke about heavy rain/thunderstorms -Getting soaked through if you ran out in the rain 	<ul style="list-style-type: none"> -Someone feeling really down about something -Someone feeling upset and crying -Feeling like they don't want to talk to anyone, they just want to be on their own 	<ul style="list-style-type: none"> -A person being nasty towards another person -One person bullying another -An angry person 	<ul style="list-style-type: none"> -A river that wasn't actually a snake it was just shaped like one -Curvy and winding river
Literal	<ul style="list-style-type: none"> -Cats and dogs coming down from the sky -Cats and dogs falling down on to houses and people 	<ul style="list-style-type: none"> -A person's skin being all blue -Their face was blue -Everything was blue – hair, face, body, clothes and shoes 	<ul style="list-style-type: none"> -A rock shaped like a heart that sinks in water -Stones in a heart -A heart in a person that was made of stone 	<ul style="list-style-type: none"> -A river full of snakes -Water snakes that rivers can be full of
Both	<ul style="list-style-type: none"> -Cats and dogs falling down with the rain -Everyone getting wet and the cats and dogs that are falling down from the sky are wet as well 	<ul style="list-style-type: none"> -Spoke about a blue person whilst mentioning they are upset and feeling down 	<ul style="list-style-type: none"> -Spoke about someone bullying someone else then said that the person's heart was actually made out of stone 	<ul style="list-style-type: none"> -A winding river that had a snakes face at the end of it, with eyes and a tongue
Other	<ul style="list-style-type: none"> -Spoke about their pets (cats or dogs) -How they know cats can walk along the fence -They can take their dog for a walk -A big swimming pool which they loved to swim in -Their house and 	<ul style="list-style-type: none"> -A blue blobby monster -The sky being blue and that makes them happy -A big crocodile and how they eat other animals 	<ul style="list-style-type: none"> -Half a heart inside a person -Stones in their garden -A real heart inside a person and that it is an organ -Cakes and said their birthday was coming up and they were 	<ul style="list-style-type: none"> -Spoke only about snakes with no mention of a river (“snakes can bite you and are poisonous so you need to be careful”) -Fish -Crocodile

	what they like to play in their garden		having a big cake	
--	--	--	-------------------	--